The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. XLVII
No. 1207

SATURDAY, AUGUST 15, 1942
REGISTERED AS A NEWSPAPER

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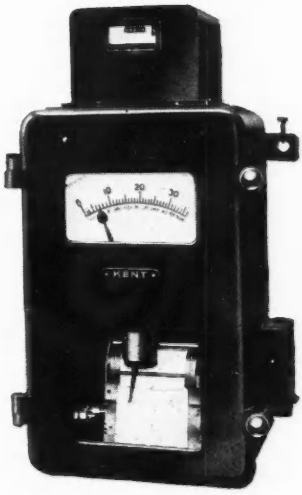

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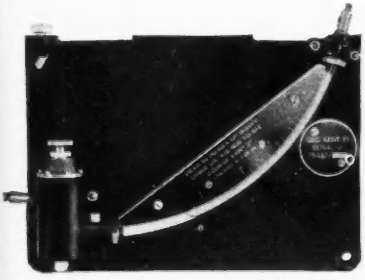

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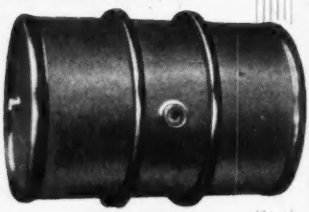

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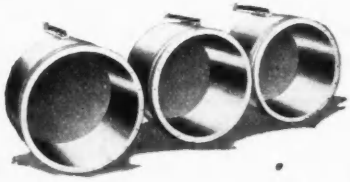

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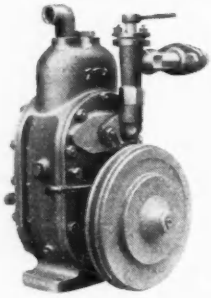

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VOL. XLVII
No. 1207

August 15, 1942

Annual Subscription, 21s.
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Fuel Economy and Chemical Industry

THE formation of a Ministry of Fuel has been advocated by technical men for many years. Now that it is an established fact it is well to note that according to the view taken by the Minister of his duties the effect on other industries may not be inconsiderable. The effect on the chemical industry may be particularly important. Coal is the principal source of carbon in this country and (theoretically) could be the basis of the organic chemical industry. Other sources of carbon are, of course, used in that industry, but since the trend in chemical manufacture is towards synthesis virtually from the elements or from some simple starting point, sources of carbon may prove to be of increasing importance. Very little is heard in this country about the Fischer-Tropsch process today, a process having as its raw materials coke and steam which enables a wide range of chemical compounds to be produced directly or by synthesis from these simple starting points. In Germany, however, the Fischer-Tropsch process is almost certainly the source of a great deal of the oil that is being used for war purposes. We believe that over 20 plants were either in operation or in comparatively late stages of construction when the war started. It cannot be doubted that many more plants have been built and that the research work that has been conducted since the war will have carried a long way farther the list of products that have been successfully synthesised from this reaction.

The Ministry of Fuel controls all fuel used in the country. Control has been exercised by the Board of Trade hitherto, but this control has been of a comparatively modest nature and has been more a matter of administration than of settled technical policy. Reconstruction is in the air. We do not know how far it will be carried. But it seems likely at the moment that fuel technologists throughout the country will urge that the policy of fuel economy which is now the subject of a nation-wide campaign both on the domestic side and in industry, shall be perpetuated by the more scientific use of fuel. The first effect of a Ministry of Fuel has already been to lay emphasis on coal conservation as well as on greater efficiency in the use of fuel in works of every kind. Each type of fuel should have its particular niche in the national economy. Too often fuels have been used for purposes for which they are uneconomic because they were sold

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at a low price on account of some peculiar difficulty in off-peak production, because of mounting stocks, or for other reasons. It is expected that the Ministry of Fuel will limit the uses of raw coal and other fuels to those purposes for which they are best suited. Such a policy cannot be put into action all at once, and it may be a long time before the rational use of fuel is general.

Coal conservation involves not only burning coal to the best advantage, but also using coal to the best advantage. One deliberate policy no doubt likely to be pursued by the Ministry of Fuel will be the up-grading of coal so that we shall get the maximum return from the raw material. This means that the raw material will be processed in such a way that it will be converted into products of much higher value. That is where the chemical industry will come in. In coal carbonisation there is ready-made a method by which the heating value of coal can be increased by reason of the greater efficiency with which gas and coke can be used in many processes as compared with raw coal, particularly for domestic uses. It is not outside the bounds of possibility that within a decade of the end of the war raw coal will disappear from the domestic grate to be replaced entirely by gas, coke, and electricity. That will mean an immense increase in the carbonising industries with an equal increase in tar distillation, ammonia production, and perhaps in the chemical utilisation of coal gas. This last is a subject to which great attention has been devoted on the Continent and many works have been built for that purpose; in this country it has been entirely neglected industrially.

The possibilities of the Fischer-Tropsch process have already been mentioned. It is very likely that research will show other methods by which coal can be utilised as a raw material. America is basing a great chemical industry on the by-products from petroleum, principally the refinery gases. The Ministry of Fuel might well encourage the refining of petroleum in this country and so enable us to set up a parallel organic chemical industry here, as has been advocated in these columns on previous occasions. Even if this policy were defeated we should still be left with coal upon which to base a great chemical industry. Almost inevitably this development will come about and, with the possibility of an increasing degree of State control of mines, there will be the encouragement of research into methods of coal utilisation. The coal industry has lately given great encouragement to the British Coal Utilisation Research Association, a body which exists for the purpose of undertaking research work into coal, and particularly into the uses of coal in all aspects. Dr. E. W. Smith, speaking at a meeting of the Institute of Fuel recently, suggested that all the fuel interests should pool their researches and form one large research association. This is the logical outcome of the formation of a Ministry of Fuel, and there is no reason why the chemical industry should not collaborate with the British Coal Utilisation Research Association by providing staff and funds to conduct researches into the chemical uses of coal with the idea of undertaking important new organic chemical manufactures in this country. The essential difficulty is that there is no one to speak for the chemical industry in matters of this sort. The A.B.C.M. is a composite body that includes all branches of the chemical industry; we cannot assume that it would have the power to provide funds for this work. It seems rather as though in the present position of the chemical industry a group of powerful firms would have to take up this matter as a commercial entity and not on behalf of the whole industry.

The same difficulty became evident during the discussion on Mr. Cremer's paper on the "Development of a Chemical Process" to the Chemical Engineering Group which was discussed in THE CHEMICAL AGE on May 9. It appears to us to be a very real defect in the organisation of the chemical industry that major developments of this sort cannot be investigated by the industry as a whole. Smaller projects can be left to individual initiative; for these great products there only exists a firm of the resources of Imperial Chemical Industries, Ltd., and they can hardly be expected to carry the whole major chemical development of the country. The inception of a research association for the chemical industry would automatically remove a great many of the difficulties and would seem to assist materially in opening the way to the chemical development of our coal resources.

NOTES AND COMMENTS

Fuel Economy Appeal

WE doubt whether the authorities could have chosen a better way of "rubbing in" the necessity for fuel economy than the course which had been adopted by the Minister of Production and the Ministry of Fuel and Power. Mr. Oliver Lyttelton has addressed a special appeal for fuel economy to the managing directors of 30,000 industrial undertakings all over the country, and has enclosed a note from the Ministry of Fuel on coal supplies. Appealing thus both to their individualism and to their patriotism, the Minister of Production says: "The Prime Minister is anxious that the seriousness of the coal position should be fully recognised throughout industry, and he has asked his colleagues to enlist the support of industrial undertakings in the measures of economy that are now necessary. In no other way can we maintain supplies for our essential industries and services, with all that that means for the successful prosecution of the war. The enclosed note by the Ministry of Fuel and Power makes a number of practical suggestions, and in asking you to give them your serious attention, I have the full support of the First Lord of the Admiralty, the President of the Board of Trade, the Minister of Supply, and the Minister of Aircraft Production, each of whom is anxious that the undertakings with which he is concerned should play their part with the rest of industry."

The Maintenance of Production

THE note by the Ministry of Fuel and Power points out that the country is faced, for some time to come, with a serious general shortage of coal, including the high-quality sized and cleaned coals which have become increasingly popular with the development of specialised types of firing plant. However efficient distribution may be, the maintenance of industrial production will depend on two things: (a) improved methods of fuel consumption resulting in a decreased total demand; and (b) the increased utilisation by industry of the types of fuel not at present in general demand, of which supplies are less short. Every effort must be made to work combustion plant as economically as possible and to reduce fuel requirements to the minimum. In order to further the Government's fuel-economy plans, discussion courses for management staff, and demonstrations for boiler-house operatives, have been arranged in some 40 industrial areas, and any firm that has not already done so is urged to participate in these training schemes. Trade Associations and Research Organisations have been asked by the Fuel Efficiency Committee to examine the most promising methods of obtaining economies in their particular industries. Here, once more, the need becomes apparent for the establishment of a central organisation for the chemical industry as a whole. We have not the slightest doubt that the various established organisations will do their utmost to assist in finding efficient fuel-economy methods, but the dangers of omission and overlapping are bound to remain under present conditions.

Planned Consumption

THE pressing need for fuel economy has given force to the arguments of those people who believe that a planned system of fuel production and consumption—covering all fuels—is overdue. Recently the question was tackled from a quarter which does not always receive the attention given to more exclusively economic interests. Mr. Arnold Marsh, secretary of the Smoke Abatement Society, said that it was estimated that 3.5 million tons of domestic and six million tons of industrial smoke and soot were emitted from the chimneys of Britain each year. On account of its much greater tarry content domestic smoke is more adhesive and generally more injurious than industrial smoke, and in London, according to the late Dr. J. S. Owens, two-thirds of the total pollution of the air is due to domestic smoke. The burning of coal in our homes is being revealed as one of the most wasteful ways of using fuel, and now Mr. Marsh stresses the fact that it is also the most unhealthy. The question that must occur to all who are interested in improving our standard of life after the war is: Can we afford to let the choice of fuels for domestic heating rest with the people who will occupy the large numbers of new houses which must rise after the war?

Costly Smoke

THE matter is not one of health only, of course, for the destruction of paint, steel, and stonework is considerable as a result of the erosive action of the acidic deposit. Sir Frank Baines once estimated that the cost of making good the results of atmospheric impurity to our buildings for the whole country could be placed at a minimum of £55,000,000 to £60,000,000 during the previous twenty-five years. He became convinced later that the actual damage was probably far greater even than this. So this less obvious economic aspect is just as important, taking the long view, as the question of using fuel in a manner which will produce from it its greatest value in heat and light. With regard to the direct effect on health of polluted atmosphere, it is pointed out that the respiration of air containing minute particles of tarry, corrosive matter, and the reduction of the intensity of daylight and sunlight and of ultra-violet radiation in the large cities by as much as one-half, are the two major factors involved. Looking into the post-war era, Mr. Marsh divides the problem into two distinct phases: first, and most urgent, the prevention of new smoke and, when that is secured, the progressive elimination of existing smoke.

Industry Must Conform

IN recent years, of course, much progress has been made. Not long ago many houses were prepared for the lighting of coal fires in any room which might be in use. In recently-built homes at least, this is no longer the case. A coal fire is a cheerful thing in the winter and as a concession to tradition electricity and gas companies have designed fires to look as much as possible like the older type of heating—even to the passing of an apparently flame-produced shadow across the surface. But even this pandering to that part of us which dislikes change even at the dictate of reason will not be necessary in a planned-fuel age, particularly when the results of the change become evident. We have said little about industry. This is because it is assumed that commercial concerns, in their own interests, tend to search out the most economic method of obtaining their power, light and heat. At the same time industry would have to conform with a nation-wide plan and might even find that old-fashioned methods of fuel utilisation were still often treated with costly indulgence to an unsuspected extent.

Canada's Search for Metals

A COMMITTEE composed of leading Canadian mining experts, under the chairmanship of Mr. R. A. Bryce, president of the Canadian Institute of Mining and Metallurgy, is investigating the possibilites of increasing Canada's output of zinc, copper, and lead. The development of Canada's metal industry in the present century has been remarkable and it is evident that, in its determination to explore every possible means of winning the war, the Dominion is not satisfied that much more cannot yet be done in this important direction. Under the Department of Mines, twenty-eight parties of prospectors and scientists are examining deposits to see what more can be got from them, as well as putting down trial shafts in areas not hitherto opened up. Search is going on for tungsten, manganese, mica, chromium, fluorine, and cobalt. This war-time activity may well set in a new era of progress for Canada in the exploiting of her great mineral resources.

Steel Co-ordination

A REAL job in the co-ordination line should be effected when the United States Steel Mission to Great Britain, which has just been appointed, gets into its stride. The duty of the mission is to study British production methods and requirements and to investigate means of increasing the supply of steel needed for the United Nations' war effort. A better balance of the steel production of the U.K and U.S.A., to ensure that a proper ratio of the various classes of steel goods is turned out; a decision as to which products can best be made in which country; and a study of possible substitutions and simplifications—these are only three of the major problems that will face the mission when it starts its work. One good thing about the mission is that it is not unwieldy; it consists of only six members, with six attached staff, so that decisions should not be tardy. The combined Production and Resources Board is to be congratulated on making the necessary arrangements for the appointment of the mission and for its visit.

Fuel Economy in Boiler Operation, IV

The Kent and Reavell-Askania Control Systems

by D. D. HOWAT, B.Sc., Ph.D., A.I.C., A.Inst.M.M.

(*Continued from* THE CHEMICAL AGE, *August 8, p. 126*)

THE Kent system of control employs the master steam regulator to vary the induced draught mechanism, proportioning the air supply to the steam demand. Other auxiliary regulators control the fuel feed and furnace draught. Both hydraulic and electrical controllers are available, and in consequence the transmission of the necessary impulses is effected by either of these means.

The Kent Master Controllers

The hydraulic master controller is composed of a bank of Bourdon tubes, which measure the steam pressure and actuate a pilot valve of opposed-nozzle type. The hydraulic control pressure is sent out by this pilot valve. By an appropriate arrangement of links the small movement is magnified and a suppressed zero provided on the control range. The working pressure may be adjusted by a spring on the tube giving a range of about 10 per cent. above and below the average control pressure.

The electrical controller consists of a sensitive piston manometer which is rotated slowly through gearing by an electric motor to eliminate the effect of static friction. A dead weight corresponding to the steam pressure is applied to the piston, which is connected mechanically to two contact members. Burning of the contacts is prevented by a mercury switch which breaks the circuit at the end of each cycle. The two contacts are included in a scheme of the gradient analysing principle. This principle takes into account both the deviation of the steam pressure from the average value and the rate of change of pressure. A comparison of these two factors enables the controller to anticipate the course of pressure variations so that a stable "non-hunting" control is achieved.

The furnace pressure controller is also made either on the hydraulic or electrical principle. The pressure from a tapping point in the combustion chamber is led to the inside of a bell suspended in paraffin oil. The prevailing suction causes vertical movement of the bell, its movements being magnified by mechanical linkages actuating the control switches or a hydraulic pilot valve. The position of the forced-draught damper is adjusted by the control gear.

The fuel/air ratio controller measures the air flow through the boiler by the differential across two passes. The pressure is applied to the interior of an oil-sealed bell suspended from two springs, while the rate of fuel feed is measured by a tachometer at the back of the controller. The movements of the bell and tachometer are linked by a shaped cam and cam-follower mounted on the end of a curved lever. When the fuel/air ratio deviates from the pre-set value, the linkages operate electrical contacts or a hydraulic pilot valve. The stoker speed is then adjusted by the control gear until the pre-set value again obtains. The contour of the cam in the fuel/air ratio controller is cut after tests taken with the boiler in operation, but provision is made to enable the ratio to be varied under different operating conditions by means of a cross-link. Where the controllers are of the electrical type, motor-driven gear boxes operate dampers, fan vanes, and variable speed gear devices. The usual hydraulic power cylinders are employed in conjunction with the hydraulic controllers. (Fig. 7).

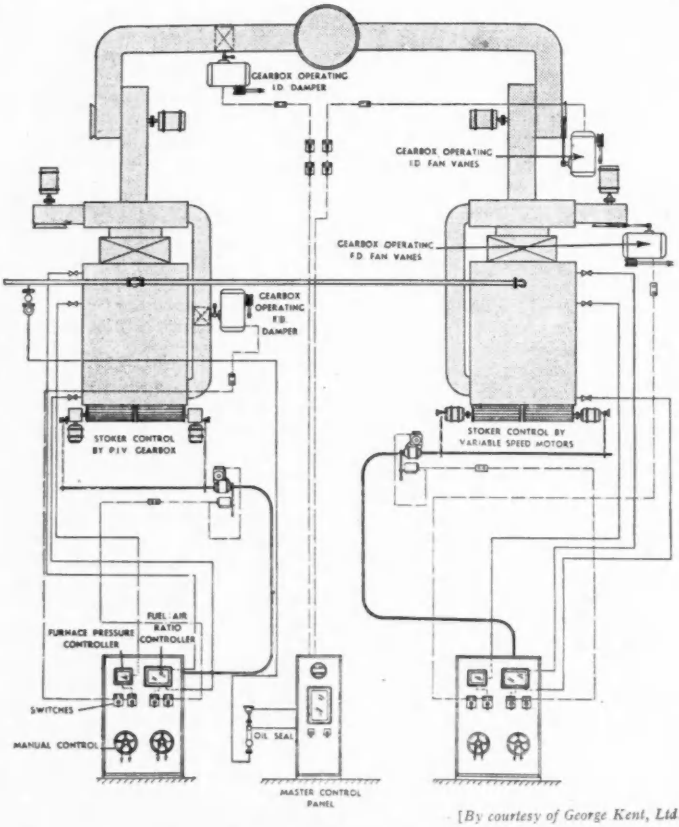
Extra Damper Control

A common arrangement of the Kent automatic system on an industrial water-tube boiler includes control of variable speed D.C. motors on the stokers and in the induced and forced draught fans, but supplementary damper control is also provided in the stack and forced-draught duct. Variations in steam pressure in the main steam header are measured by the master steam controller, from which hydraulic impulses are sent out, actuating the power cylinders on the induced-draught fan dampers in each individual boiler. Should the variations in steam pressure be greater than damper movement alone will accommodate, the hydraulic impulses are transferred to the shunt regulators on the induced-draught

fans. The regulators are ganged together by rack-and-pinion or chain drive and operated together by a power cylinder. The furnace-pressure controller preserves balanced draught by adjusting the damper in the forced-draught duct and, when necessary, the shunt regulator of the fan. The fuel/air ratio controller measures the air flow through the boiler and adjusts the speed of the stoker to preserve correct proportions.

The gear used in conjunction with B & W boilers of 184,000 lb. per hour maximum continuous rating and fitted with Babcock type " E " mills may be taken as an example of the application of this system to pulverised-fuel firing. The automatic combustion-control equipment includes temperature control of the primary air to the pulverising mills. The superheat temperature is automatically controlled by the operation of flue-gas dampers.

Hydraulic impulses from the master steam-pressure controller in the main steam head are used to operate the induced-draught mechanism. On each furnace are fitted two Howden vane-controlled fans driven by two-speed motors. Maintenance of the draught conditions to



[By courtesy of George Kent, Ltd.

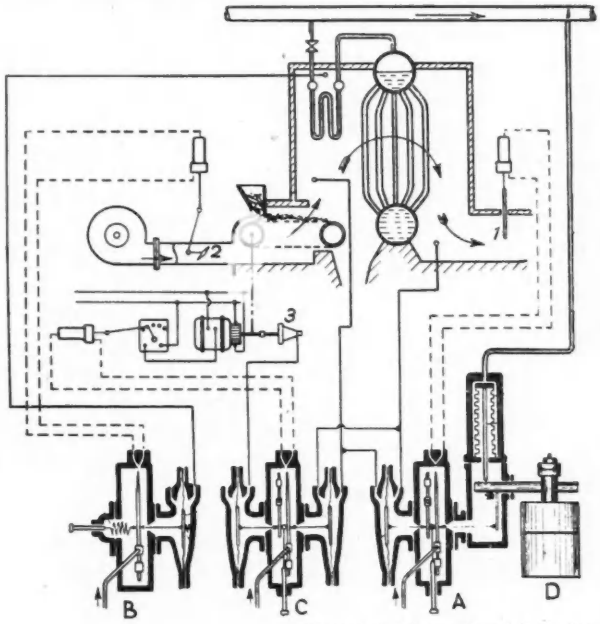
Fig. 7. Diagram showing the lay-out of two alternative methods of controlling a boiler by the Kent electrical system. Left: Stoker control by gearboxes and draught control by dampers. Right: Stoker control by variable-speed motors and draught control by fan vanes.

A. Master steam regulator, measuring steam load and controlling induced draught damper (1) so that gas flow through boiler varies in accordance with load.

B. Furnace pressure regulator, which maintains balanced draught by controlling forced draught damper (2).

C. Combustion regulator: measures air flow through furnace and also fuel supply by fan (3) on stoker shaft; regulates stoker speed through rheostat on D.C. motor, so that constant fuel/air ratio is maintained.

D. Counterweight to equal drum pressure.



[*By courtesy of Messrs. Reavell & Co., Ltd.*

Fig. 8.—Diagram of Reavell-Askania control system applied to stoker-fired boiler.

load demands is ensured by power pistons, which select the appropriate speed and also adjust the vane ring on the fans. The forced draught is regulated by a power piston operated by the furnace pressure controller.

The control of the fuel feed is effected finally by varying the amount of primary air sent to the pulverising mills. Three pulverising mills, equipped individually with a mill/air ratio controller, are fitted to each furnace. The air flow through the furnace is measured by a fuel/air controller directly connected to a mill-proportioning controller. The hydraulic impulses from the fuel/air controller are distributed in equal proportions to each of the pulverising mills in operation by the proportioning controller. A master fuel distributor, working in conjunction with the proportioning controller, sends out hydraulic impulses to the individual mill/air ratio controllers. These controllers measure the primary air input to the mill and adjust the quantity in accordance with the hydraulic impulses from the master fuel distributor. The quantity of primary air depends upon the position of a damper in the mill air duct, the damper being operated by a power piston subject to the air ratio controller. The mills are driven by constant-speed motors, variation of the primary air supply being the only method of fuel control.

The temperature of the air to the pulverising mills is controlled by automatic gear. The main supply of secondary air from the heaters is tapped to provide primary air for the mills. A tapping is taken off the duct from the forced draught fans before the air heaters, the cold air being circulated through a ring main, from which branches are taken to the mills. The temperature of the primary air supply to the mills is maintained constant by mixing hot and cold air in the correct proportions. The temperature of the fuel/air mixture leaving the mills is measured by a controller from which hydraulic impulses are sent out to two power cylinders, one controlling the position of the damper in the hot

air duct and the other that of the damper in the cold air duct.

The Reavell-Askania System

The Reavell-Askania system, incorporating exact methods of measurement for each of the quantities to be controlled, operates entirely on the hydraulic principle. The power pistons controlling the feeder mechanisms are supplied with oil under pressure by means of a jet-pipe relay designed and patented by the company. The relay comprising the measuring gear is the means by which minute variations in steam pressure are transmitted to the feeder control gear. Oil at high pressure is delivered from a fine nozzle in a jet pipe on to a distributor containing two small orifices lying in the same plane and immediately adjacent to one another. The two orifices are connected to pressure tubes, one feeding to the top end and the other to the bottom end of the power cylinder. The jet pipe, attached at right angles to a push rod, moves in a horizontal plane between two stops. (Fig. 8).

With the jet pipe in mid-position, the stream of high-pressure oil impinges equally on both orifices and the power piston remains stationary at the centre of its stroke. The movement of the push rod is derived from the metering system, a bellows diaphragm or Bourdon pressure tube being employed to transmit pressure variations to the push rod. A variable spring on the other side of the jet pipe balances the force set up by the diaphragm and so prevents "hunting" or overtravel. By a screw adjustment the tension of the spring may be varied to suit different operating conditions. When a variation occurs in the pressure in the main supply line, a corresponding movement occurs in the diaphragm, the position of the jet altering in turn. When the jet is at any point other than the exact centre between the two orifices, an unequal pressure will be set up and the power piston will move to a new position. As conditions return to normal the power piston will gradually resume its mean position.

When applied to stoker-fixed boilers the master steam-pressure regulator fixes the position of the induced-draught mechanism or damper, the position of the jet pipe in the relay being determined by the steam flow and the differential draught across the boiler. From a tapping point in the boiler outlet pipe the pressure is connected to a bellows diaphragm, the pressure in the diaphragm being counterbalanced by a weight hung on the opposite end of a pivoted beam. If the counterbalancing weight is made equivalent to the drum pressure in the boiler, a residual force will be exerted on the pivoted beam proportional to the pressure drop from the drum to the tapping point. This residual force applied to the jet push rod is therefore proportional to the square of the steam quantity. By tapping two suitable points, the draught loss across the boiler may be measured, the pressure at the two selected points being connected to either side of a plate diaphragm. The diaphragm transmits the force representing the differential draught loss through a second push rod to the jet pipe; the position of the jet pipe is therefore dependent on the balance of the two opposing forces. When the steam demand is high, the jet operating through the power piston opens the damper, inducing a greater flow of air through the grate, while a drop in steam demand results in shutting down the draught.

Control of Combustion

With stoker-fired furnaces the amount of fuel fed is of secondary importance to the air flow through the fuel bed, but correct control of stoker speed is essential for efficient combustion. Provided the CO_2 content of the flue gases is constant the differential draught loss is proportional to the amount of air entering the furnace, and is the gauge employed to control the stoker speed to secure correct fuel/air ratio. A small suction fan is direct-coupled to the stoker feed-motor shaft, the inlet pipe being connected to one side of a plate diaphragm. The differential draught loss across the boiler, as measured by two suitable tappings, is connected to either side of a plate diaphragm. The position of the jet relay is fixed by the balance of the forces set up by the two opposing diaphragms. If the draught loss across the boiler increases, the jet, moving to a new position, causes the power piston to operate the rheostat control on the D.C. stoker motor. Alternatively, the speed of the stoker motor may be controlled by a Ward-Leonard system to vary the supply voltage. A further form of control is available where A.C. or constant speed D.C. stoker

motors are employed, the motor being run for only a definite fraction of the operating cycle. Special gear is required for frequent starting and stopping, but apart from this no other modifications need be made to the stoker drive. This may be an advantage and simplifies erection work.

Where both forced- and induced-draught fans are fitted to a furnace, the pressure at a point high up in the tubes should be approximately level gauge, the two fan actions balancing one another. Level gauge at this point will represent a slight draught over the grate. A jet relay operated by a diaphragm is employed, the boiler tapping being connected to one side of the diaphragm. The relay is set for level gauge by an adjustable spring; the power piston, operated by the jet, controls the position of the forced-draught damper.

Pulverised-Fuel-Fired Boilers

As already indicated, complications exist in the application of automatic control to pulverised-fuel-fired boilers, varying modifications and additional controls being specified in different systems.

The supply of fuel to the burners is the principal means of control in furnaces of this type. The Reavell-Askania system includes the provision of a Ward-Leonard motor generator set to control simultaneously and equally the speeds of all the individual coal-feeders to the mills. The generator set provides variable-voltage D.C. supply to the feeder-motor brushes. As the excitation voltage on the feeder motors remains constant, the speed of these motors depends entirely on the voltage supplied by the Ward-Leonard gear. The master steam pressure controller operating through a jet-pipe relay and power piston, controls a variable resistance, which determines the generator excitation current. In addition a small positive air blower is direct-coupled to the shaft of each feeder motor. By placing an orifice plate in the blower line a differential pressure is created equal to the square of the amount of coal fed to the mill. All boilers under control of the master regulator have a similar measuring system, and by coupling up to a common pipe with an orifice a differential pressure is set up proportional to the square of the total fuel supply. The master regulator is of the double-diaphragm type described under stoker-fired boilers. Variations in steam demand are imposed on the bellows diaphragm, while the differential pressure proportional to the square of the total fuel supply is connected to the opposing diaphragm. The position of the jet pipe is determined by the balance of these two opposing pressures and this in turn controls, through power piston, rheostat, and Ward-Leonard gear, the speed of the feed motors on the coal mills.

A combustion controller, fitted to each individual boiler, is of the double-diaphragm type. The differential pressure set up by the positive air-blower attached to the feeder-motor shaft is connected to one diaphragm. The opposing diaphragm is subjected to the differential pressure across the air-heater, a value proportional to the square of the total air supply. The position of the jet is therefore determined by the balance of the air and coal supplies. The power piston, controlled by the jet, operates the forced draught damper—a decrease in the coal supply reducing the forced draught, an increased demand for steam opening the damper. Furnace pressure is controlled in exactly the same way as with stoker-fired boilers. Level gauge pressure is maintained near the top of the tubes by controlling the movement of the induced draught damper.

Primary Air Fuel Ratio

The quantity of fuel fed to pulverised-fuel burners depends on the amount of primary air. With rapid fluctuations in load, control of primary air is much more important than that of the coal fed to the mills. As a first approximation the ratio of pulverised fuel to primary air may be taken as constant, and a Reavell-Askania regulator is provided to vary the position of the damper controlling the feed of primary air to the mill. In the opposed-diaphragm type, one side of the regulator is connected to the differential pressure set up by the small positive fan coupled to the coal-feeder motor. The other side receives the differential pressure impulses set up by an orifice plate in the primary air line. Following a change in steam pressure in the header, the coal-feeder motors vary in speed so that the primary air/fuel regulator in its turn opens or closes the damper to co-ordinate the primary air with the fuel feed. With the usual unit mill system the direct proportion of primary air and fuel does not hold

at low loads, a subsidiary regulator being installed to increase the percentage of primary air required under these conditions.

To prevent "hunting" of the various control systems, some type of overtaking gear is provided to readjust the regulator after a certain travel of the control gear. The jet pipe is returned to the mean position, suspending the action of the regulator and allowing time for conditions to stabilise before further change is made. A hydraulic overtaking gear is provided in the Reavell-Askania system, consisting of a cylinder attached to the back of the regulator. Inside the cylinder a piston, normally held in the mean position by two springs, is connected by a link to the adjustment, the setting of which is varied when the piston moves. By connecting this cylinder in series with the control cylinder, the overtaking-gear piston follows all the movements of the power piston. The overtaking-gear cylinder is provided with an adjustable by-pass through which oil may leak. By this means the piston returns to the mean position and with it the jet pipe, so suspending the action of the regulator in the desired manner indicated above.

The following firms have supplied technical data and publications relating to the various systems of automatic boiler control: Electroflo Meters Co., Ltd.; Bailey Meters and Controls, Ltd.; George Kent, Ltd.; Reavell and Co., Ltd. The author takes this opportunity of expressing his appreciation of the help given. A special word of thanks is due to Messrs. George Kent, Ltd., for the selection of photographs made available as illustrations.

A CHEMIST'S BOOKSHELF

SPECTROSCOPY AND COMBUSTION THEORY. By A. G. Gaydon. London: Chapman and Hall. Pp. 191. 17s. 6d.

This book is not a comprehensive treatise, but is an attempt (and a singularly successful one) to convey to the chemist with little physical theory or mathematical ability the past developments and future trends in a difficult but valuable field of research. Most chemists are familiar with the wide application of spectroscopic methods in present-day analytical chemistry. The number who have any well-founded knowledge of other uses of spectroscopy must be much smaller. As Dr. Gaydon's book shows, the study of band spectra may be applied to commercially important studies such as the behaviour of the internal combustion engine. Of course, the primary interest of the application of spectroscopy to flames, explosions, and luminescence is theoretical; but this does not preclude the chemist who wishes to keep abreast of modern developments (and what good chemist does not) from satisfying a curiosity regarding the topics which are here made easily available.

Dr. Gaydon treats, in a simple and almost entirely descriptive fashion, subjects such as the spectroscopic investigation of hydrogen, hydrocarbon, and carbon monoxide flames, and the consequent development of the theory of reaction mechanics. Cool flames, afterglows, and the spectroscopically acquired evidence on dissociation energies, flame temperatures, and activation are all dealt with adequately in the limited space at the disposal of the author, and within the limits of simplicity which he has wisely imposed on himself. The book should make straightforward and fascinating reading for anyone with even a slight grasp of the modern theories of the production of spectra. It is to be welcomed, both for its subject matter, and for the example which it sets to writers of monographs on the less familiar topics of chemistry; and it is a worthy companion to *The Identification of Molecular Spectra* by Pearse and Gaydon (reviewed in THE CHEMICAL AGE, 1941, *44*, 338).

Gas Concentration Test

Photo-Electric Method

THE photo-electric cell is now used in America to determine the concentration of a particular gas in any mixture of gases. This "electric eye" method, which is claimed to be extremely accurate and able to indicate dangerous concentration of gases in the air, comprises a gas-receiving cell, through which can be passed a beam of light. On the opposite end of the cell is the "electric eye" on which the light falls; it converts the light into an electric current, varying in proportion to the amount of light passing through the cell. Included in the apparatus is a pumping device which selectively removes the gas, the concentration of which is to be measured, from the mixture. First the gas mixture is passed through the cell, then to the purifier and back into the cell. The difference between the amount of light absorbed by the cell when it contains the gas mixture and that absorbed when the cell holds only the purified gas is noted by the photo-electric cell and is indicated by variations in electrical current which can be amplified to operate a dial showing the concentration of the gas in the mixture

Mercury for Process Heating

Efficient Operation at High Temperatures

by H. SEYMOUR

IN selecting an industrial heating system for high temperature work a number of major factors should be considered. These include fuel, temperature control requirements, operating risks and convenience of operation. These important factors obviously vary considerably with each individual problem and it is, therefore, impossible to state a definite preference for any one heating system until all the factors have been considered and their relative values carefully weighed. The fuel cost of a heating system is frequently an appreciable part of the cost of operation of an industrial process, and a manufacturer who commits himself to a fuel supply when it appears to be of secondary importance, frequently finds himself confronted with unusually large fuel bills. He finds that he is at a disadvantage as compared with one who had been able to balance all the factors carefully when the initial installation was made. This situation often arises because of the relatively small magnitude of the process or system as originally installed and because of its subsequent rapid development and expansion. Proper study of the original problem, with a glance at the future and an estimate of possibilities of expansion, will result in the selection of a cheaper fuel and a design of equipment which will give greater operating efficiency.

Convenience of Gas Fuel

Of the "combustible" fuels, including coal, coke, oil and gas, the most convenient is, without doubt, gas. By its use a large portion, if not all, of the operating labour may be eliminated by the installation of suitable automatically controlled devices. An almost unlimited supply of fuel is made available at the user's door by public service, thus eliminating a considerable amount of investment which might otherwise be required for storage and distribution requirements. It renders the manufacturer independent of fluctuations in market price, delays in delivery, and other uncertain factors which are involved, especially with a fuel such as coal.

Heat Systems Classified

Utilisation of heat from any fuel source may be effected by one of several industrial heating systems. These may be classified under the broad headings of direct fire, steam, circulation systems and electricity. Each of these divisions may be subdivided into its various special groups, depending upon how it is to be applied and the heat and temperature requirements. Each of these systems has its advantages and disadvantages. The temperature range of some is too limited; in others the efficiency and fuel economy are very low; or the risk is too great; or the control is not close enough, and so on.

In many cases the direct application of fire to a vessel gives satisfactory heating results, but where delicate processes are involved and careful control required it may be very unsatisfactory. For example, a precise indirect heating system is preferable for the heating of explosives or combustible material. From the capacity viewpoint alone, the indirect heating system using condensing vapours is quite superior to the direct fire system. Heating equipment by direct application of a gas flame or combustion gases frequently involves a heat transfer rate of about five to ten per cent. of that obtainable with steam vapours and, therfore, requires either a corresponding increase in the temperature head between the combustion gases and the product to be heated or a corresponding increase in heating surface. A compromise design involving both high temperature head and as large a heating surface as possible is usually finally evolved. The amount of available heating surface frequently limits the capacities for heat input, since this is usually determined by the surface of the vessel to be heated, whereas with an indirect heating system an almost unlimited amount of heating surface may be installed as heating coils or heating fingers.

Circulating Systems

Ordinary steam is ideal from the viewpoint of cheapness and ease of control, but unfortunately, it is not generally applicable to temperatures above about 175° C. Making allowances for temperature head, it is necessary to have boiler pressures in excess of 150 lb. in order to reach higher temperatures. Such pressures are usually difficult to justify in usual plant operation. In some instances where a steam supply is already available at a pressure of from 50 to 100 lb. below that required to reach the temperature desired, a steam compressor may be economically employed to raise the pressure to that desired. Circulating systems of various kinds have been developed to meet the requirements of processes operating at temperatures above 150° C. These systems may circulate oil, water under pressure, hot gases, or molten metal. Oil circulating systems are frequently used, but are somewhat dangerous owing to the inflammable nature of oil and the difficulty of keeping pipe lines and kettles tight enough to hold the oil under the pressure required for the rapid circulation which is necessary to give a sufficient heat transfer

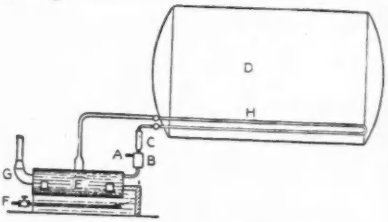
rate. In addition, they are fairly expensive to instal, sluggish in operation, and the oil is subject to an appreciable amount of decomposition or cracking during use. The fire risk is never completely eliminated and the hot oil is a potential source of serious fire even with the best and latest design of systems. The heat transfer of liquid circulating systems is low, and it is difficult to maintain pumping equipment to keep the liquid circulating at the required rate to give reasonable heat transfer values.

Electricity is in use for special heating problems, but is often subject to the objection of high operating cost. Its application usually is limited to locations where power cost is below 1d. per kW, or where power cost is neglible and overheating not objectionable. For temperatures above about 200° C. the maintenance of the ordinary electric systems becomes appreciable.

Mercury Vapours

The most recent developments in high temperature industrial heating include the use of mercury vapours in a manner similar to that of ordinary water vapour or steam. This development has been extended to include the combustion of gas for generating the mercury vapours and offers a considerable number of advantages over direct heating systems. This practical and efficient method of transferring heat at high temperature has been in successful operation for a number of years. The first commercial installation was in successful operation in 1915. It is especially applicable to processes requiring a delicate temperature control within the temperature range of 170° C. to 440° C. Recent developments in this system allow operating temperatures as high as 475° C. By use of the mercury heating system it is possible to control the temperature of a kettle or other vessel within a few degrees of any specified or predetermined value.

The application of the mercury heating system to a vessel is easily accomplished. It may be attached directly to either a jacket or coil. The boiler is mounted in a brick setting and contains the mercury. It is heated by means of gas burners controlled by a valve, the waste gases passing up the stack or through an economiser. The mercury vapours delivered by the boiler flow into the jacket of the vessel which is to be heated, the condensate returning through a cooler and separator to the boiler for re-evaporation. The control of the temperature of the system is by means of the pressure maintained upon the boiling mercury. A vacuum or pressure connection is made to the separator and by controlling this pressure it is possible to raise or lower the temperature 50° or 100° within a few minutes. For heating stills, evaporators or similar equipment, the mercury heating system may be attached to ordinary coils as with steam. The high rate of heat transfer and large temperature drop obtainable give extremely high rates of heat input with very small heating surface. By this means the maximum output from such apparatus may be obtained without overheating.



Mercury system for heating stills, evaporators, and similar equipment.

A.—Vacuum or pressure connection to separator to raise or lower temperature. B.—Separator. C.—Cooler. D.—Vessel being heated. E.—Mercury boiler. F.—Gas burner control valve. G.—Stack. H.—Heating coil.

In case of emergency where instantaneous cut-off of heat is required the vacuum is broken by means of a vent valve and instantly the boiling ceases and no more vapours are given off. The fire is then shut down until operation is to be resumed. The high heat content and rapid turnover of the mercury in the system give very high capacities with a small mass of that substance. Units may be brought up to full operating capacity in from 15 to 30 minutes and shut down in two or three minutes. They start equally well in cold or hot weather and in many respects are directly comparable with a steam heating system. One of the most valuable properties of steam for heating purposes is the high unit rate of heat transfer obtainable therewith. This permits of heating a vessel to a temperature closely approaching that of the steam itself, since but little temperature head is required to effect the desired rate of heat transfer. In many respects mercury vapours are nearly identical with that of steam. Heat transfer rates in excess of 700 B.Th.U./hr./sq. ft./° F. have been reported as being obtained between mercury condensing vapours and boiling water. This is even in excess of that obtained between condensing steam and boiling water.

Another advantage of the steam heating system, and likewise an advantage of the mercury heating system, is that the high latent heat of evaporation is fully realised when steam or mercury vapours are condensed for heating purposes. This feature cannot be realised by circulating or direct fired systems which depend entirely upon the sensible heat of the fluid. While the heat of evaporation of mercury is much less that that of water, the density of the vapours formed is correspondingly greater, so that for a given amount of heat the volume of mercury vapours is actually appreciably less than the

volume of steam required to liberate an equivalent amount of heat upon condensation This permits of the use of pipe lines of relatively small dimensions and makes the unit heating system quite compact.

In most installations the mercury boiler required is of very small size in comparison to the vessel being heated. While the mercury vapour has in some cases been transmitted over 100 ft., still the matter of piping economy and heat radiation dictates that the kettle be kept close to the source of heat. This means that a clean and easily controlled fuel must be used. For the small heating plant gas has offered a number of advantages in addition to those mentioned and has, therefore, resulted in its selection as a heating means for the new mercury system. By this combination of the gas-fired system with the mercury heating system, the many values of a vapour heating system may be realised and yet the excess cost due to the use of electricity, which is frequently used as an indirect heating means, is eliminated and many advantages gained over the electric heating system. Furnace temperatures may be easily controlled and, owing to the great advance in gas furnace design, it is now possible to obtain a furnace which contains elements to divert radiant heat into mercury vapours in a manner somewhat similar to the action of the electric element in the electric furnace. Refinements in gas furnace design have been adapted to mercury boilers and standard gas-fired mercury units in sections of approximately 100,000 B.Th.U. per hour of capacity each have been developed. These sectional units can be linked in parallel to give any desired capacity with a minimum of changes in furnace design.

High Fuel Efficiency

Where a number of pieces of equipment are to be heated the single boiler installation affords a means for obtaining very high fuel efficiency. It renders possible the use of preheaters and heat economisers and the operation of a single boiler unit at an economical rating regardless of fluctuations in load of the various pieces of equipment heated thereby. Special indirect operating valves have been developed whereby it is possible to control the flow of mercury vapours at least as readily as ordinary steam is controlled. There appears to be no limit to the number and size of the equipments which can be heated by a single boiler unit. Automatic valves have been devised which render operation of the mercury boiler entirely independent of the equipment to be heated, so that there is a continuous supply of mercury vapour available, regardless of the load upon the system. With large scale operation this permits the operator to work entirely independent of the boiler, which may be placed with the steam boiler equipment and operated by the same firemen.

In the case of a 30,000 B.Th.U. per hour gas-fired unit used for experimental work, including petroleum distillation and cracking, and also for distillation of a number of explosive compounds, it was found possible to distil even nitrated compounds which ordinarily could not be purified by distillation because of the danger of overheating and causing serious explosion. By using mercury vapour it was found possible to fractionate these products and to isolate portions with very high purity. This boiler, one of the earlier designs, is similar to an ordinary horizontal fire tube boiler built up of heavy welded steel. The mercury vapour rising in a central 3 in. pipe was condensed in a coil contained in the still. Excess vapours were caught in the auxiliary vertical condenser and returned to the boiler. The mercury boiler may be designed to give thermal efficiencies as high as 70 per cent. although this is not normally required, an efficiency of about 55 per cent. usually being sufficiently high for normal industrial heating purposes. Efficiencies even lower than this are sometimes used where the waste gases may be employed in preheaters and economisers. This design has been used for a large evaporation problem wherein the liquids fed to the evaporator are to be pumped through a preheater located in the flue from a mercury boiler, the mercury vapours being employed in the tubes of the evaporator.

Recent Boiler Types

The boiler in the installation referred to was operated with two 1¼ in. low-pressure pipe burners in parallel and was set up in one end of a large industrial shop. No particular attention was paid to the furnace installation during the use of the apparatus. The furnace was hand-operated and forced in order to bring the mercury rapidly up to temperature, and afterwards adjusted to the approximate rate required to operate the still at the desired capacity, excess vapours being dissipated by the cooler. A later design of gas-fired boiler has been recently designed and built for operation in oil refineries. This boiler, known as the finger type, usually consists of six vertical fingers suspended from a large horizontal header. This design is such that additional fingers may be added as desired. A number of headers may be installed in a single setting, thus giving a boiler which may be easily and cheaply enlarged to take care of increasing load. The overall size of the boiler itself, which is capable of delivering 100,000 B.Th.U. per hour, is 4 ft. long by 3 ft. high by 8 in. wide. This boiler is suspended in a gas-fired brick furnace approximately 5 ft. long by 3 ft. 2 in. wide by 4 ft. high.

Installations have been made with six surface combustion burners which are set so as to play directly on the lower portion of the vertical fingers. This layout with its blower

and control is practically automatic and requires very little attention. It is to be regretted that the nature of the processes on which this type of unit is operated is such that details of the design, operation, and test results cannot be made public. The mercury heating system has been extended, however, to many diversified uses. Among these is the special case of quickly abstracting heat from an exothermic reaction in a vessel at temperatures between 400° and 465° C. To meet this condition a body of boiling mercury is kept in thermal contact with the vessel to be cooled and its temperature controlled by regulating the pressure thereon. The vapours arising from the boiling mercury dissipate the heat by condensation in an external cooler and are returned in the jacket for re-evaporation.

Heating and Cooling Combined

This new system has particular application in certain chemical reactions wherein very careful control of delicate reactions is required and wherein very large quantities of heat are frequently liberated by the reaction. Combinations of heating and cooling systems have also been worked out and are in successful operation. In these cases the mercury system is used both for heating the product to the reaction temperature and for abstracting heat from the mass after the reaction has been initiated. Temperatures involving operation of the mercury under pressure are rendered available by perfection of construction methods and by other developments. These include use of atmospheric pressure or vacuum for temperatures of between 390° C. and 450° C., which previously required a pressure of between 20 and 70 lb. A large variety of sizes of equipment with either automatic or manual control have been built from the laboratory unit of 20,000 B.Th.U. per hour up to plant equipment rated at 1,000,000 or more B.Th.U. per hour. Units of 4,000,000 B.Th.U. per hour are being considered for acid concentration.

Such systems are beyond the experimental stage and have proved their worth in the high temperature heating field because of the advantages of easy operation, accurate temperature control over wide ranges, safety of application, and high efficiency. The question of leaks, of prime importance in a circulating system where such high temperatures are used, has been successfully solved by the advance in the art of welding during the past ten years. Properly designed and installed mercury heating systems give no trouble from leaks. Operating risks with the mercury heating system are practically nil when normal precautions are taken. By using the indirect heating system open flames are removed from the vicinity of the equipment, and the fire danger even with inflammable products is practically eliminated. Many volatile coal tar products have thus been safely distilled.

It is a matter of record that in many years of operation of mercury boilers and mercury turbines and the years during which the mercury system has been applied to industrial heating, there has been very little, if any, real illness attending the operation of such systems. It is understood that in the development of the high speed turbine which operates at very high temperatures and during the alteration of certain heating equipment, minor cases of mercury poisoning resulted, but in every instance where an investigation was made, it was found that illness was caused directly by the negligence of the mechanic affected. The development and use of welded construction for the equipment and operation under vacuum or at low pressure eliminates the possibility of a dangerous health hazard in the mercury heating system. As mentioned above, vacuum may be developed for temperatures even in excess of 450° C.

U.S. Synthetic Rubber

Roosevelt Vetoes Congress Plan

PRESIDENT ROOSEVELT has vetoed the Bill under which Congress would have created a Rubber Supply Agency, independent of the War Production Board. He has, however, appointed a Committee under the chairmanship of Mr. Bernard Baruch, to examine the whole field of synthetic rubber production, and to report as quickly as possible. Dr. J. B. Conant, and Dr. K. Compton, President of the Massachusetts Institute of Technology, are other members of this Committee. The President pointed out that artificial rubber processes were now in a state of flux; some were still experimental, and others had shown varying degrees of efficiency. It was obviously impossible to determine the advance which would eventually prove the most desirable. It was in order to ascertain the facts that the Committee had been appointed. Meanwhile, however, the manufacture of artificial rubber would continue uninterruptedly.

A new process, using highly volatile solvents, is reported to have been developed in Germany to facilitate impregnation of indigenous timbers with synthetic resins, lignite, ozokerite, and similar substances. The products are substituted for imported hardwoods. Impregnation is carried out in a closed vessel, and the solvent is extracted after impregnation by application of under-pressure. Special advantages are that the wood need not be dry, as the water is expelled by the solvent, and that the treated timber does not swell and is very hard.

COLLECTED NOTES ON CHEMICAL SAFETY

Diverse Factors Contributory to Accidents

by JOHN CREEVEY

CONSIDERING all the known facts concerning "accidents" that take place in the chemical industries in the course of a year, there is ample evidence to show that a large number would have been avoided if greater caution had been exercised. The word "caution" is used, as distinct from "precaution," to imply caution aroused by the commonsense thinking of circumstances, as distinct from precaution taken from a knowledge of accidents with similar plant or processes. While precautions generally may be well established as part of the works' safety code, individual thinking as a contribution to safety is not always exercised to the full by the whole of the personnel.

Utilising Discarded Plant

At the present time much discarded plant is being usefully adapted for further service, although once regarded as "scrap." Here there is particular need to be cautious of danger which may lie dormant as an inheritance from the previous service of the plant. If the history of the plant or plant-part is uncertain, a careful inspection must be made before any conversion or repair is attempted, especially by the use of welding, and in any case before there is the least application of heat. It is possible that some chemical deposit may be present which can be decomposed by heat, giving inflammable gases, quite apart from the likelihood of decomposition with explosive violence. Even the mere dismantling can be risky, owing to friction when separating component parts or by the detonating effect of hammer blows on metal in contact with an unsuspected deposit. An explosion in a dismantled galvanised steel tank (*Chem. Met. Eng.*, 1924, *30*, 546), followed the third or fourth blow of the hammer to aid the removal of a pipe connection; the explosion was found to be due to a deposit of nitro-cellulose in an unstable form. In another case, the unscrewing of a joint on a disused coil (*Chem. Age*, 1927, *17*, 255) caused friction which exploded a deposit of some nitro-compound carried over by the condensing vapour when the coil was last in use. The galvanised steel tank had previously been in use as an alcohol measuring tank, and the coil had been used for condensing acetone vapour; both prior uses, so far explained, were harmless enough, but in both cases the plant had been in use in connection with the manufacture of explosives; any inheritance of danger in this connection seems to have been ignored although it afforded sufficient warning that circumstances might be slightly different as regards the abuse of hammer blows and friction.

In many cases where discarded plant is now being put to further service, there seems to be little or no effort made to ascertain its history; sometimes that history is uncertain, sometimes wholly unknown, in particular to the persons now handling the "scrap." The presence of some deposit of chemical nature, even if it is merely corrosion choking a pipe connection, is highly probable, for plant which has been dismantled as "scrap" (or temporarily left lying about the works) is not often cleaned out thoroughly before entering upon its period of idleness. Even with the precaution of washing out the interior, it is not always possible to remove any dangerous deposit that may be present; in a case recorded (*Chem. Age*, 1919, *1*, 498), although the interior was washed out to remove objectionable fumes, this seems to have had no effect on a dangerous deposit which had accumulated during previous use, and which "flashed" on percussion.

"Empty" Tanks and Drums

Tanks and drums which have held inflammable liquids and have stood idle for a few days or weeks are a source of danger from the residual vapour within them, especially when the removal of a manhole cover, or the bung of the drum, is effected in such a manner as to cause sparks; likewise by the use of a naked flame close at hand at the time of opening. Inflammable vapours, however, are not the only source of danger; tanks with residual acid may easily collect an accumulation of hydrogen gas, by action of acid on metal, and the resulting mixture of hydrogen and air is highly explosive in its confined space. This danger from the evolution of hydrogen is found also in lead-lined acid eggs, where acid has passed through some defective part of the lining and has so reached the underlying iron; any lead-lined egg which shows signs of internal "blisters" must be regarded with suspicion, and the wisest thing to do is to repair the lining as soon as possible.

Even where a particular acid has no effect upon a particular metal used in the construction of the tank, circumstances may so change that there is ultimate danger. An explosion, due to the ignition of an unsuspected accumulation of hydrogen by a naked light, occurred while inspecting a tank wagon which had been standing idle for a considerable period (*Ann. Rep. Insp. Factories*, 1923). This tank wagon had last

been in use for the conveyance of concentrated sulphuric acid; though the concentrated acid did not attack the constructional steel, it was a simple matter for the small residue of acid in the tank to become diluted by moisture derived from the air and so give favourable conditions for attack with evolution of hydrogen while the tank was standing idle. The danger of sparks when removing a manhole cover on tank wagons, apart from the use of a naked flame for inspection, has been emphasised frequently, and yet it is found that inspections are still carried out without the use of properly enclosed safety lamps, and that manhole covers are still being removed without the use of spark-proof tools made of bronze.

Cylinders of Compressed Gases

All cylinders of compressed gases should be marked with bands of coloured paint to indicate the nature of the contents; other forms of labelling alone are not always sufficiently distinct. The explosion of an ammonia refrigerating machine (*Warme u. Kalte Tech.*, 1922, *24*, 280) was caused by replenishing the machine with an oxygen cylinder in mistake for an ammonia cylinder.

Other Sources of Works Fires

Certain causes contributory to an outbreak of fire are common enough, yet they are not kept in the limelight of publicity as much as would appear desirable. Included are worn or frayed ends to flexible electric cable; switches with loose connections; machine bearings which are not properly oiled; dirty and oily electric motors; overloaded motors; dirty flues; accumulations of combustible matter close to some source of heat, such as steam pipes or flues; and, not least, a general disregard for the spontaneous ignition danger of oily rag and engineers' waste. Fires also start where welding operations are not supervised; where static charges are likely to be built up close to inflammable vapours; where electric light bulbs are allowed to make contact with combustible material; and (though quite apparent but still needing mention) wherever a naked flame is used or sparks are not properly confined, with combustible material in the same building or shed. It is surprising to notice that while a spark arrester is provided for the boiler-house shaft, there is often complete disregard for numerous small chimneys serving the needs of individual processing furnaces at the same works; yet these chimneys offer a much greater danger of fire on a windy day and with the likelihood of bad stoking as compared with boiler-house practice.

Carbon Disulphide Fires

Carbon disulphide vapour can be ignited at temperatures as low as −20° F.; it will ignite spontaneously in air at 300° F. If water and sand only are available, one of the most satisfactory ways of extinguishing a blazing tank of carbon disulphide is to introduce water quietly at the bottom of the burning liquid so that it will rise to the top without splashing (*Chem. Met. Eng.*, 1927, *34*, 83). Carbon tetrachloride is not wholly satisfactory as an extinguishing agent unless the amount used is equal to the amount of disulphide actively involved in the fire.

Static Dangers with Naphtha

Oils of the nature of naphtha develop a static electrical charge while being pumped through pipe-lines, especially pipes of small diameter (*Chem. Met. Eng.*, 1922, *26*, 4). It has also been shown that air blown through an iron pipe (which has conveyed naphtha) on a damp day, will cause the naphtha vapour to ignite at the end of the pipe as it passes into the air. A potential of 300 volts may be developed by benzine flowing through a metal pipe (*Chem. Z.*, 1923, *47*, 97); the liquid acquires a negative charge, and the pipe takes a positive charge. The danger from the accumulating static charge is offset by earthing the pipe-line, storage tanks, and pumping equipment; it is not sufficient to earth only the pipe-line.

USES OF WASTE PICKLE LIQUOR

The use of waste liquor from pickling plants has greatly expanded in Germany during recent years. Ferrous chloride liquors are used by paint factories for the manufacture of iron oxide colours. Iron sulphate salts obtained from sulphuric acid waste liquors are used in agriculture to eradicate charlock, for the manufacture of paints, as a catalyst for the production of motor spirit, and for the wet desulphurisation of gases. In future a larger part of the output of iron sulphate is to be roasted to yield sulphuric acid and iron ready for use in the furnace. It is also intended to use ferrous chloride liquors and iron sulphate salts for the chemical precipitation of town waters.

CONTROL OF DRIED FRUIT PESTS

The Control of Insects Infesting Dried Fruit (H.M. Stationery Office, 6d.) is another pamphlet in the series dealing with aspects of the problem of infestation of produce by insects. The greater part of the pamphlet, after a description of the commonest insect pests concerned, explains in detail how the dried fruit itself can be cleaned by fumigation with a mixture of ethylene oxide and carbon dioxide in a cheap and easily erected fumigation chamber. This can be supplemented, when the fruit is in store, by the regular use of an insecticidal spray, which is specified.

Hazards of Spray Painting

Increased Risks from War Conditions

by A. E. WILLIAMS, F.C.S.

IN the painting and lacquer industry the introduction of labour-saving appliances has increased the risks to which the worker is exposed, both in the shape of maladies hitherto unknown to the trade, and the danger of fire and explosion. During the war years these dangers become more widespread as newcomers are introduced to the industry. These conditions are mainly due to the drastic changes in the technique of painting accompanying the various spraying devices now in use, and alterations in the composition of paints and lacquers themselves, which are imposed in part by the current scarcity of certain materials.

Lead Paint Problems

For example, the dangers of lead paints are accentuated when these are sprayed, and for this reason some undertakings have prohibited the spraying of these paints. Many attempts have been made to find a satisfactory substitute for lead in paints, but up to the present time no suitable material has been found to replace lead entirely in certain classes of paints, although, so far as interior decoration is concerned, substitutes such as titanium white, lithopone, and zinc white are coming into favour both in Great Britain and in the U.S.A. Such pigments are comparatively harmless, with the possible exception of zinc white, which sometimes contains lead. For exterior work, however, white-lead paints are often chosen owing to their capacity for withstanding atmospheric conditions over long periods.

Another risk peculiar to spray painting is met with in using paints containing fine particles of silicate or quartz. When sprayed, such particles are liable to be carried into the lungs of the workmen, and set up silicosis. The risk of fire or explosion is intensified when a highly inflammable paint or lacquer is sprayed. This danger may arise either from solvents or thinning agents used in the paint. Beyond a short note as to its inflammability it is rarely that manufacturers of paints or lacquers state the nature of the ingredients of the material, so that the user is frequently at a loss to know what precautionary measures to take in using the paint. It is obvious that the danger of fire or explosion is greater when such materials are sprayed, because of the fine mist of solvent caused by the spraying pistol.

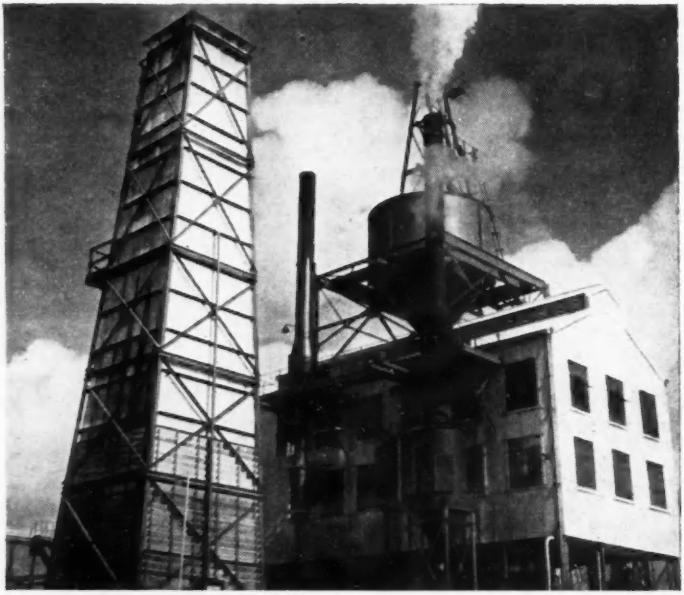
Another potential source of danger, long known in the dry-cleaning industry—wherein several serious fires have arisen from the cause—is that such solvents as benzine, ether, and the solvents produced by hydrogenation may become heavily charged with electricity, through internal friction, when passing through a non-conducting material such as rubber tubing, on emerging from which sparks are emitted, thus igniting the vapour. To overcome this danger it is necessary to earth effectively all parts of the spraying equipment, including the spraying pistol itself. The risk of fire has, in some cases, been reduced by incorporating a non-inflammable solvent with the normal paint or lacquer to be sprayed. Chlorinated hydrocarbons, such as carbon tetrachloride and trichlorethylene, are examples of these. These two solvents are also poor electrical conductors, but they have one serious disadvantage, in that they are injurious to the worker's health. Moreover, the extent to which the chlorinated hydrocarbons may be used is restricted by the limited properties of these solvents, many of the specific characteristics desired in an efficient paint or lacquer being absent in such agents. In the present state of our knowledge, therefore, other means have to be adopted, and in this connection improvements have recently been effected in the spraying apparatus itself.

Solvent Recovery

The formation of vapour clouds during spraying is also minimised by reducing the air-pressure operating the spraying pistol. Probably the greatest safeguard yet is the immediate evacuation of the vapour-charged air from the scene of the spraying. This is not difficult to accomplish with the spraying of small articles, which may be partially or wholly enclosed in a cabinet, or covered by a suitable hood. In such circumstances any inflammable solvent vapour present is easily drawn off through an exhaust duct. But with larger goods, such as rolling stock and items of military equipment, etc., the withdrawal of the vapours from the atmosphere is a more difficult problem, and other measures of protection, such as the use of masks, special overalls, etc., have to be taken. When the spraying installation is comparatively large and of a stationary character it is usually possible and worth while to recover a large proportion of the solvent from the working atmosphere. To this end carbon solvent-recovery plants have been installed in some undertakings. The proportion of solvents recoverable with such plants depends, of course, upon the particular types in use, but the British-made recovery plants generally show a higher recovery ratio than is obtainable with the older German type of plant.

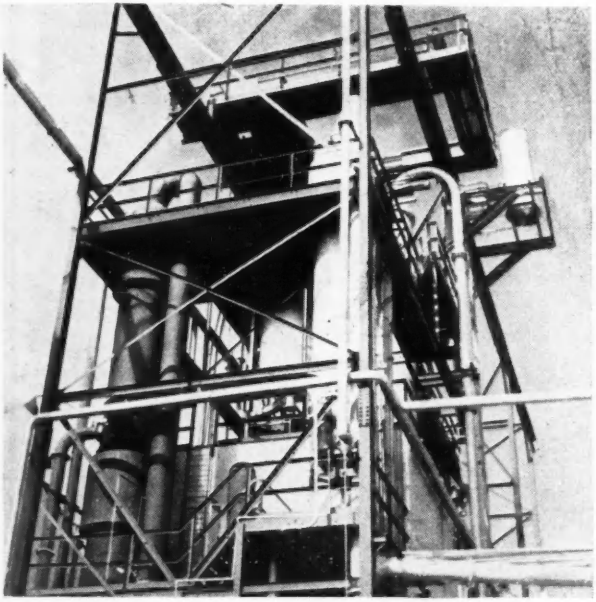
Australia's Chemical Progress

Advances in Explosives Manufacture



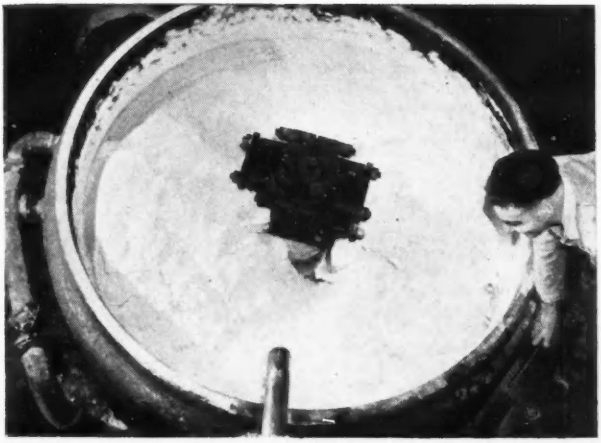
At the new nitric acid and ammonium nitrate works near Melbourne: the water-gas producing plant. On the right is the plant proper, supplied with coke through the giant hopper in the roof; on the left is a water-cooling tower.

IN this war, just as in the war of 1914-18, the chemical industry in Australia is taking a substantial step forward both in production from established factories and in the opening of new plant. Between the years 1914 and 1920, 863 new factories of all kinds came into operation in the Commonwealth and of these 80 were chemical works. Progress during the present conflict is not so well defined by the information available, but that it is considerable is indicated by the references to the great effort being made which come from time to time. Before the war Imperial Chemical Industries had in hand projects involving the investment of about £2,000,000 in Australian industries which included a sum of £300,000 to be spent on factories for ammonia synthesis and oxidisation and the manufacture of nitrocellulose. The development of the explosives industry in the Commonwealth is linked with the progress in mining which is the means by which Australia exploits much of her natural wealth. The greater proportion of explosives produced outside the Commonwealth Government munition factories was manufactured at the Deer Park plant of a company which merged, in 1925, with the Nobel concern. In 1911 the Commonwealth Government established an explosives factory in Victoria as part of a comprehensive defence scheme and by 1935 more than £3,000,000 were invested in Government arsenals. There can be little doubt that important extensions have been made in the seven years since these figures were published. The goal in view at that time was, not only to render the Commonwealth self-contained in the matter of munitions, but to enable it to supply other Dominions and supplement United Kingdom resources in case of emergency. In her own peril Aus-



The main tower for the production of liquid ammonia, of which large quantities are consumed. The tower is over 100 ft. high.

tralia will no doubt need all the munitions she can make and it is fortunate that she took the steps to increase her output. A glimpse of the work being done is given in the accompanying pictures. The new plant at Melbourne produces large quantities of nitric acid and ammonium nitrate vital in the manufacture of explosives as well as in many other branches of the chemical industry.



The final stage in the production of ammonium nitrate; the liquid reduced to a fine white powder in a huge steam-jacketed kettle.

Anti-Corrosive Paint

New Developments from a "Waste" Product

THIS war, like the last, is proving a great stimulus to ideas in industry. Many of the best brains in the country are concentrating on the problem of making most advantageous use of raw materials available for war-time production, and some of the resultant discoveries will endure after the war, to the lasting benefit of the community. On the one hand manufacturers are seeking substitutes for raw materials which have become either unavailable or strictly controlled, and on the other hand there is a constant search for outlets for materials which before the war were considered as waste. Many happy "marriages" have taken place, one of the most recent being in the paint industry. The full story cannot be told yet, for security reasons, but it can be said that Lewis Berger & Sons, Ltd., have been able to produce a new metal-protective paint with the help of material which, before the war, was a waste by-product. To-day, but for the use of this waste material, it would be well nigh impossible to manufacture so effective a metal-protective paint because of the shortage of imported material. The waste by-product has an important future in the industry for it is cheaper than the imported material which it so effectively replaces.

Water-Repellent Properties

The company's chemists, by a process of their own, produced from the erstwhile waste by-product a wax-like substance which, among other attributes, has remarkable water-shedding properties. This substance forms the basis of the new metal-protective coating and makes it strongly water-repellent. Corrosion due to water or water vapour has an entirely electrolytic origin and the anti-corrosive value of a protective coating in such cases is determined both by its pigmentation and by the nature of its binding medium. Some binding mediums are better than others for bringing out the anti-corrosive value of pigments, and the new medium has proved to be very effective in this respect. The new paint, which is called "Frust," has just been marketed after a long period of research and experiment, and Lewis Berger & Sons, Ltd., have given THE CHEMICAL AGE the following details about it. Its manufacture does not involve the use of any imported oil. It has good anti-corrosive properties, preventing rust by exclusion of water or moisture from the metal. It is claimed that it gives effective protection on any outdoor surface, iron, wood, stone, or concrete, and that it has a durable quality unmatched in ordinary paints in the sense that it dries by evaporation of solvents and remains always elastic whereas ordinary paint dries by oxidation which eventually causes breakdown.

From tests now proceeding it is hoped to show that a surface that has been coated with "Frust" (and on which the paint has aged) can be recoated with ordinary paint, unlike surfaces that have been painted with bitumen paints, which "bleed through" or stain subsequent coats of ordinary paint.

Canadian Chemicals

Points from the Dominion Convention

THE response by Canadian farmers to the demands of the production programme for a 300 per cent. increase in the output of flax-seed has been disappointing, according to a statement made to Canadian chemists by Mrs. Phyllis Turner, Dominion Administrator of Oils and Fats. Present indications are that the crop will show less than 100 per cent. increase over last year, and it would appear that some of the demand made upon Canadian linseed oil, both locally and in the U.S., will go unsatisfied.

Production of active silica from serpentine, a waste by-product of the Canadian asbestos milling industry, has been developed in the laboratories of the National Research Council, according to Mr. D. Wolochow, of the Council's Division of Chemistry. As magnesium sulphate, or Epsom salts, is recovered at the same time, the active silica can be prepared at a low cost. The silica is of special use in furthering dry-blast pig-iron production.

Phosphatic open-hearth slag from the steel furnaces at Sydney, Nova Scotia, has been applied with success to arable fields in that province, best results having been obtained with a rapidly cooled slag. Immediate use of more of this slag on a large scale was advocated by Mr. F. E. Lathe, of the National Research Council.

Detailed production figures for sulphuric acid in 1940 have now been published, and give an idea of what may be expected from subsequent developments. The sulphuric acid output increased to 312,599 tons (66° Bé) in 1940 from 249,558 tons in 1939. Of seven plants operating, two, those at Trail, B.C., and at Copper Cliff, Ont., operated entirely on sulphur-bearing smelter gases. Only 142 tons of sulphuric acid were imported during 1940 and 2244 tons were exported. Exports of acids were valued at $2,700,000, and total exports of chemicals, mostly cyanamide, ammonium sulphite, and sodium compounds, amounted to $17,300,000.

COMPANY MEETING

Benn Brothers, Limited

Mr. Robbins's Address: Pocket-Size Journals

THE Forty-Sixth Annual General Meeting of Benn Brothers, Limited, proprietors of THE CHEMICAL AGE, was held at Bouverie House, Fleet Street, E.C.4, on August 7, the chairman, Mr. Gordon Robbins, presiding. The chairman moved a resolution approving the report and accounts for the year ended June 30, 1942, and recommending that the following dividends be paid, less tax, on August 15: 3 per cent. on the preference shares (making with the interim dividend of 3 per cent. paid on February 14, a total of 6 per cent. for the year ended June 30, 1942); 11 per cent. on the ordinary shares (making with the interim dividend of 4 per cent. paid on February 14 a total of 15 per cent. for the year ended June 30, 1942); and 3s. per share on the deferred shares.

Mr. Gordon Robbins said that he hoped the report and accounts would be regarded as satisfactory in the exceptional conditions. The contraction suffered by the business in the earlier period of the war had been at least temporarily arrested, as all the main heads of the company's revenue showed an expansion beyond the figures of the two previous years. The revenue from both advertisements and sales, the chief items on the credit side of the company's trading accounts, had been substantially increased. Interest and dividends stood at a higher figure, as did rents from Bouverie House lettings, representing, as they now did, the satisfactory return of approximately 6½ per cent. on that investment. There had to be set against the comparative buoyancy of the revenue an increase in expenditure, the chief contributor on this side being an all-round rise in printing charges. The final adjustment between revenue and expenditure in the profit and loss account showed that on balance the company had moved in the right direction. The net profit carried to the balance sheet stood at £44,981, as compared with £37,127 on June 30, 1941.

Position of Reserves

The first concern of the board, said the chairman, loyally abiding by the cautious policy pursued over many years by Sir Ernest Benn, was to consider the position of the reserves. They made the usual allocation of £1500 to leasehold reserve, and allocated to the Jubilee Pension Fund £3000, a sum slightly higher than the amount actually disbursed under that head in the last financial year. The board had already in the previous year reserved the whole of the amount estimated to be needed as the five years' contribution under the War Damage Act of 1941. With a general reserve already standing at £130,000 and an investment reserve fully meeting the position at £8181, the board were still not content with their appropriations for foreseeable contingencies and allocated £10,000 to a new taxation reserve. Income tax and National Defence Contribution, being based on a comparatively lean year and in part on a lower rate of tax than was levied to-day, stood at a lower figure than a year ago. Next year and the year after, that figure would be progressively higher and the taxation reserve would have a steadying influence on the company's figures.

Increased Ordinary Dividend

"After these generous allocations were made," said Mr. Robbins, "it was found that there remained available a larger amount than a year before. The directors accordingly decided that the time had come to recommend the restoration of the ordinary dividend to the figure at which it stood on the eve of the outbreak of war. It will be something, particularly for the smaller shareholders who form the majority on the company's register, to have the ordinary dividend back at 15 per cent. The board will make every effort to maintain that figure, although they are fully alive to the possibility of unexpected checks to the operation of the company's business as long as the war lasts. The position of the company has been satisfactorily rounded off by the carrying forward of a balance of £13,995, an increase of a little more than £2000 over a year ago."

The company's investments at cost in British Government and various commercial and industrial securities now stood at £167,025, as compared with £132,564 a year ago. It held, in addition, shares to the amount of £86,000 in its subsidiary company, of which the repayment of all but £2000 figured on the assets side of the balance sheet.

Although the year covered by the report and accounts was a difficult one in various ways, the strain on the board and the staff was somewhat easier than in the two previous years. "I would sum up the period," said Mr. Robbins, "by the company's experience in the first year of war as holding on, in the second year as hanging on, and in the third year as carrying on." If there was no unexpected development in this last year, every wartime problem presented it-

self in a more acute form. More urgent and insistent than any was the problem of paper supplies, and when the Ministry of Supply fixed the ration at its present figure of 19½ per cent. of the amount used in the last year before the war, the board decided upon a bold course. They decided to reduce eight of the company's thirteen trade and technical journals, including all the largest users of paper, to pocket size 8½ in. by 6 in. The board were confident that advertisers and subscribers would freely accept the explanation, if any were sought, that this drastic change in the appearance of the journals was dictated solely by overriding national needs. This confidence was not misplaced, for it was on record that of the thousands of subscribers and hundreds of advertisers having a direct interest in each of the eight journals hardly a score queried the decision.

"What is much more surprising than the hearty co-operation of the great business constituency served by these journals," the chairman went on, "is the widespread approval of the new size, coupled with the hope that it had come to stay. Indeed it may be that the board have stumbled by accident on the trade journal size of the future, although obviously on such a cardinal issue they intend to keep a very open mind. One proved advantage of the new size has been the securing of a better balance between the editorial and advertising contents, to the benefit of the reader. The carrying through of this transaction has firmly buttressed the truth, accepted by the Government from the beginning of the war, that the publication of established trade journals is an indispensable national service."

Advertisements Rationed

For the first time in the history of the company, advertisements had had to be rationed and even refused, and new subscribers had to undergo a period of probation by being placed on a waiting list. It had been established up to the hilt that each of a dozen important industries in Great Britain cannot do without its Benn journal. The company's export trade journals had probably had a more difficult time than those primarily concerned with the home market. The healthy position in which the export journals still found themselves was attested by the launching of a fourth publication in a foreign language. This was a French Supplement to *The British Trade Journal*, to carry the message of British production to the Fighting French and Belgian possessions oversea.

The staffing of the business had become increasingly difficult, with the call-up of valued servants of the company for national service now extended with an ever increasing intensity to women. The board had loyally responded to the demands of the Ministry by making representations for deferment only in the case of key members of the staff and they had so far succeeded in retaining or obtaining the minimum man-power and woman-power needed for the efficient conduct of the business. The most striking result had been the transfer of much greater responsibility than before to women, and the board were happy to recognise that quality and enterprise, the company's distinguishing badges, had thereby been fully maintained.

Three Chairmen in 62 Years

"This is the third occasion," said Mr. Robbins, "on which it has fallen to me to give the shareholders an account of the board's stewardship. Now, however, I present myself to you for the first time as the chairman of the company. I am only the third holder of that office in the sixty-two years' existence of the business. My predecessors were Sir John Benn and Sir Ernest Benn, and it is as great a gratification to me as it must be to you that there are younger members of the distinguished family from which the business takes its name to carry the torch hereafter. It was a characteristically generous gesture by Sir Ernest Benn which led to my induction into the office I am very proud to hold."

Mr. Norman French seconded the motion. He said that although they were still rationed regarding paper, they had been able to widen the distribution of the journals and also widen the services they provided. One Government department alone had produced over one hundred new orders during July, and it was the job of their editors not only to settle their own problems, but the problems of industry caused by new legislation.

The resolution was carried unanimously. On the proposal of Mr. K. E. Hughes, Sir Ernest Benn was re-elected a director of the company. Sir Ernest Benn recalled the fact that he must have attended forty-four of the forty-six annual meetings. "During the last few years," he continued, "and particularly during the last three, we owe a great deal to Mr. Gordon Robbins. I did what I could to assist him during the "blitz," and notwithstanding all the kind things said about me—the more I oppose people, the kinder they seem to be—I contend that no living man could have successfully coped with the amazing problems better than the man who now occupies the chair." During Mr. Robbins's temporary absence last winter, Mr. Norman French had proved himself a good G.S.O.2.

Mr. Frank H. Elliott said that he admired Mr. Robbins for the geniality and energy with which he conducted their mutual affairs. Mr. B. A. Glanvill moved a vote of thanks to the Chairman.

Personal Notes

DR. W. L. GLEN, B.Sc. Hons., Ph.D. (Glasgow), D.Phil. (Oxon), A.R.T.C., A.I.C., has just joined the staff of J. F. Macfarlan & Co. at their Edinburgh works.

DR. ALEXANDER LAWSON, who has been Lecturer in Chemistry at University College, Southampton, since 1931, has been appointed to the University Readership in Organic at the London (R.F.H.) School of Medicine for Women. He enters upon his new duties on October 1.

On the result of the 1942 Associate-Membership Examination of the Institution of Chemical Engineers, it has been decided to award William Macnab Medals to MR. JOHN HENRY SHARP and MR. FREDERICK JOHN WILKINS. Six other candidates were successful in the examination.

DR. T. HEAP, A.I.C., who has been head of the Chemistry Department of the Wigan and District Mining and Technical College since 1938, has been appointed to succeed MR. N. B. RADCLIFFE as head of the Batley Technical College. Mr. Radcliffe retires at the end of August. Dr. Heap was formerly lecturer in chemistry at the Battersea Polytechnic.

MR. J. DOUGLAS LORIMER, Canadian Chemicals Controller, resigned from his post last month, according to an announcement made by the Hon. C. D. Howe, Dominion Minister of Munitions. Mr. Lorimer is resigning because of increasing responsibilities as managing director of a large chemical manufacturing concern; acceptance of his resignation is being held up, pending the appointment of a successor.

Obituary

MR. ERNEST RONALD WITHELL, head of the Department of Pharmacy and Biology, Birmingham Central Technical College, died at Keswick on August 10 as the result of a motor-cycle accident on Honister Pass in the Lake District. Mr. Withell, who succeeded Dr. E. G. Bryant at the College in 1939, was only 31, but had already made a distinguished name for himself by his researches on bactericides.

New Control Orders

Machinery

Under the Export of Goods (Control) (No. 32) Order, 1942 (S.R. & O. 1942, No. 1533, price 1d.), which comes into force on August 24, control is extended to cover additional types of machinery. Licences will, in future, be required to export to all destinations: steel scaffolding and fittings therefor; cocks, taps, traps and valves, wholly or mainly of metal, for controlling gases, liquids, or vapours; asphalt cauldrons; boring and percussive machinery for pile driving; fans, blowers, and exhausters, power driven; air washers, filters, dust collectors and dust separators ancillary thereto; pulley blocks and parts thereof, wholly or mainly of metal; pumps and compressors, wholly or mainly of metal; steam turbines and turbine condensers; blade wheels, casings, diaphragms and rotors therefor; tar-spraying machinery; vacuum cleaners, non-domestic; water turbines, and casings and runners therefor. Licences will also be required to export electrical goods of various descriptions.

Quinine

The control of cinchona and cinchona products and synthetic substitutes (No. 1) Order, 1942 (S.R. & O. 1942, No. 1604), which came into force on August 13, controls quinine and all other alkaloids of any variety of cinchona, cinchona itself, and any synthetic product which is a specific for malarial infections. The use of the controlled material is strictly limited to the treatment of malaria, or by a prescription for any purpose where a registered medical practitioner considers it essential. All holders of stock which, calculated in terms of quinine, is 25 oz. or more must notify the Director of Medical Supplies, Ministry of Supply, Portland House, Tothill Street, S.W.1.

Parliamentary Topics

Research Co-ordination

FOLLOWING the deputation which was recorded in THE CHEMICAL AGE on July 25, a motion suggesting the establishment of a new central body to co-ordinate scientific and technical research and development for war purposes has been tabled in the House of Commons by Captain Leonard Plugge and 19 other members of all parties. The motion reads:—"That this House is of the opinion that present circumstances require the early establishment of a whole-time Central Scientific and Technical Board to co-ordinate research and development in relation to the war effort and to ensure that the experience, knowledge, and creative genius of British technicians and scientists exert a more effective influence over the conduct of a highly mechanised war."

Synthetic Rubber

Another interesting motion has also been tabled, in this instance by Major Braithwaite and other M.P.s, to the effect that "this House, while appreciating the help promised by the United States of America, considers that in the national interest and to give the fullest support to the war effort arrangements for the production of synthetic rubber should be commenced immediately in this country."

General News

From Week to Week

A Fuel Savings Week, the first of its kind in the country, opened at Guildford last Saturday. It is being held in conjunction with the town's Holidays at Home campaign.

The Fullers' Earth Union, Ltd., Redhill, have been elected Trade Members of the British Cast Iron Research Association. Mr. R. H. S. Robertson is their representative.

Spun rayon fabric dyers have followed the example of other processing and finishing sections of the industry and formed themselves into a "group" which will plan production with a view to present and also post-war possibilities.

The Cantor Lecture on "Soil Physics—Theory and Practice," which was delivered by Dr. B. A. Keen, of Rothamsted, last January, has now been published in the *Journal of the Royal Society of Arts* (1942, *90*, 4618, pp. 546-579).

Fireclay and silica refractories are now controlled as part of the Chrome Ore, Magnesite, Wolfram and Foundry Bonding Materials Control under the Ministry of Supply. Mr. H. Halliday has joined the Control as Director in charge of these materials.

The Ministry of Fuel and Power, pursuing its fuel economy campaign, has issued some striking figures revealing the amount of fuel used by lifts. London's lifts, for example, use about 200,000 units of electricity a day, or 50,000 tons a year. So, as the Ministry says, "Before you press that button to call the lift—stop to think!"

"Help has been given to industrial firms by our works chemists on how they can effect a saving in gas, and in many places business executives have appointed members of their staffs to see that fuel is saved," said Mr. R. Weston, manager of the British Gas Company, talking in Norwich in connection with a fuel economy exhibition.

The chemist (Dr. D. N. McArthur) and the bacteriologist (Dr. Malcolm), of the West of Scotland Agricultural College, were among those who addressed a company of representatives of agricultural merchants' firms at a "refresher" course on silage-making held last week at the College's experimental farm, Auchencruive.

A demonstration of how science has been harnessed to the task of feeding the Army was given at a War Department laboratory in London this week. A display of German rations captured in Libya made an unfavourable comparison with the British ration. Analyses have shown that the German process of dehydration fails to retain the vitamin-C content.

Three hundred factories have been set up in Britain by refugees. They include works for the production of glycerine for explosives, optical glass and metal alloys. Over one hundred industries entirely new to Britain have been established by refugees since the Nazis came to power.

The Government has ordered the Petroleum Board to reduce supplies of liquid fuel (other than paraffin or petrol), *i.e.*, fuel oil, gas oil, diesel oil, creosote and creosote pitch used for central heating and domestic purposes. Every effort will be made to apportion reduced supplies equitably, says a statement issued by the Ministry of Fuel and Power.

The Pascall Engineering Co., Ltd., announce that in future their address for postal deliveries will be Monitor Works, 114 Lisson Grove, London, N.W.1 (Tel: PADdington 7236), and that for goods deliveries, Monitor Works, Goods Entrance, 48 Broadley Terrace, London, N.W.1 (Tel.: PADdington 7237).

In view of the immediate need in this country for a trustworthy method for the determination of rotenone, the publication of an account of an improved method (Coomber, Martin and Harper, *J.S.C.I.*, 1942, *61*, 7, p. 110) is particularly timely. It is noteworthy that the chloroform, carbon tetrachloride, and benzene used in the separation were all of "AnalaR quality, and that the apparatus illustrated is covered by Quickfit and Quartz standard numbers.

In view of the shortage of technical specialists in illuminating engineering, factory executives are requested, by the National Industrial Electric Lighting Service, to forgo, where at all possible, their established practice of obtaining numbers of alternative plans for amendments to their lighting installation. There is, however, no objection to obtaining a number of estimates based on the same specification, as technical staff is not thereby involved to the same extent.

Foreign News

A new company for magnesium reduction has been organised and incorporated at Cleveland, Ohio, U.S.A.

Schlesische Chemie A.G., Breslau, has raised its capital from 600,000 to 12 million marks and has been authorised to issue shares for another 4 million marks. The new shares have been taken over largely by Phrix-Werke (a leading cell-wool producer) and Georg von Giesche's Erben (who hold important interests in the Silesian zinc-lead industry). The company has also evinced interest in a plant connected with the mining and smelting industry.

In Hungary a new glue factory, which will also produce casein products, has been erected at Sajetshar.

A scheme for the production of caustic soda in Algeria is among the projects for the industrialisation of French North Africa. Local salt deposits are to supply the raw material.

The French armaments combine, Schneider-Creusot, has acquired a controlling interest in Etablissements Barbet, makers of chemical apparatus, who also operate distillation plant.

Difficulties in local transport have induced the Germans to reopen one of the potash mines in Polish Galicia, although these were heavily damaged during the invasion of Poland in 1939.

A number of old-fashioned mills in Croatia are reported as having been equipped by the Axis with apparatus for the extraction of maize-kernel oil (for use in the soap industry) by a new method.

A decree recently issued by the Reich chemical authority restricts the production and processing of polyvinyl chloride to firms in Germany who were manufacturing this material during the period, January, 1940—April, 1941.

Large deposits of phosphate on the farm Langberg, about 40 miles from Cape Town, are to be developed now that no more phosphate can be imported into South Africa from Morocco. The phosphate is needed for the steel industry as well as for the manufacture of munitions.

L'Air Liquide is proposing to double the producing capacity of its plant at Dakar (French West Africa). The demand for oxygen and acetylene in France is very brisk, but power and raw material difficulties have prevented the company from meeting all demands.

The increased use of peat as a fuel in Denmark has led to efforts to utilise the ash as a fertiliser. This ash, however, is difficult to handle, and though it contains useful amounts of lime, and of potassic and phosphatic material, experiments have shown that these contents vary erratically.

Photographs of the recent raids by the R.A.F. on the Western Ruhr show that, among other extensive damage, a shed in a zinc and sulphuric acid works in the Duisburg-Heidrich district was completely demolished and others damaged, while an extraction plant in a tar distillery was destroyed.

Another high record in the output of salt in the United States has been announced for 1941. Aggregate production of all three classes of salt—evaporated, rock, and salt in brine—came to nearly 12¾ million short tons, representing increases for the year of 20, 16, and 27 per cent. respectively. Apparent consumption per head rose from 151 lb. in 1940 to 191 lb. in 1941.

Idle mining plant in the heart of the Queensland rubber-vine country has been acquired by the state Agricultural Department of Australia for the purpose of extracting rubber from the vines. This plant will co-operate if the results obtained from the pilot plant installed at Brisbane justify such a course.

Increased study of new sources for rubber has been undertaken by the B. F. Goodrich Co., Akron, Ohio, according to Dr. H. E. Fritz, director of research. Dr. Harlan L. Trumbull, who has been manager of the chemical research department since 1922, has been selected to head the new research project.

The blowing-in of a new furnace by the Canadian Furnace Co., Port Colborne, Ont., has been reflected in an increase of about 250 tons per day in Canadian pig-iron production. Two more stacks are under installation, one at Sault Ste. Marie, Ont., the other at Sydney, N.S., with the result that the end of the year will see 14 blast furnaces in Canada with a total productive capacity approximating 2,700,000 tons annually.

The entire alcohol production from the sulphite cellulose factories in Finland for the next five years has been bought by the State Alcohol Monopoly. At the normal rate of production this would cover about 40 per cent. of the country's motor fuel requirements, but the cellulose output has declined owing to export difficulties, and the production of alcohol is proportionately lower, although all sulphite cellulose plants are now equipped with apparatus for the recovery of alcohol. It is proposed to produce alcohol direct from wood by a saccharification process.

America is planning a greatly enlarged home tin smelting industry after the war. According to the War Production Board, the government-financed Texas City plant is designed to have a smelting capacity of 74,000 tons of refined tin per annum, and will be in a position to take care of most, if not all, of the refined tin requirements of the U.S.A. The consensus of opinion in the metal trade is that the tin smelting industry in the United States has not only come to stay, but that American refined tin will largely supplant the foreign article in the domestic market.

Forthcoming Events

On **August 26**, at 4 p.m., at the Imperial Institute, South Kensington, there will be a conducted visit of the London and S.E. Counties Section of the **Institute of Chemistry** to the Exhibition galleries (tea and film-show included). Only 50 members can be accommodated. Application should be made to the Secretary, and a ballot will be held. Applicants securing places will be informed of their good fortune.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

JARROW METAL INDUSTRIES, Ltd. (M., 15/8/42.) July 17, series of £200,000 debentures, present issue £150,000; general charge. *£38,000. January 2, 1942.

PREMIER COAL-OIL DEVELOPMENT PLANT, LTD., London, S.W. (M., 15/8/42.) July 15, by order on terms, £7000 bond, etc., to Baron Brocket, charged on land, buildings, plant, etc. *£2000. January 20, 1942.

CALCIUM PRODUCTS & FERTILISERS, LTD., Cefn Coed. (M., 15/8/42.) July 24, debenture to Lloyds Bank, Ltd., securing all moneys due or to become due to the Bank; general charge. *——. December 29, 1941.

XETAL PRODUCTS, LTD., Nottingham, rubber manufacturers. (M., 15/8/42.) July 18, charge, to Westminster Bank, Ltd., securing all moneys due or to become due to the Bank; charged on property, etc. *—. December 4, 1940.

BARROW HÆMATITE STEEL CO., LTD., Barrow-in-Furness. (M., 15/8/42.) July 23, 2nd debenture to Lloyds Bank, Ltd., securing all moneys due or to become due to the Bank; general charge (subject, etc.). *£293,865. July 11, 1941.

LONDON & SCANDINAVIAN METALLURGICAL CO., LTD., London, S.W.—(M., 15/8/42.) July 18, debenture securing to New Trading Co., Ltd., all moneys now due or to become due to the holders for loans advanced under credit arrangements (other than special credits arranged in connection with exports to the Argentine) or on any other account; charged on the undertaking property and assets of company present and future other than its freehold and leasehold properties, fixed plant and machinery, but including its uncalled capital for the time being. *——. August 7, 1941.

Company Winding-up Voluntarily

WEST LANCASHIRE SAND AND LIME CO., LTD. (C.W.U.V., 15/8/42.) By special resolution, July 31. Philip Slater, 413 Lord Street, Southport, appointed liquidator. All claims against the company have already been paid, or will be paid, in full.

Bankruptcy Information

KOHN, PAVEL, 9 Florence Court, Maida Vale, London, Doctor of Chemistry. (R.O., 15/8/42.) Receiving order July 28. Creditor's petition.

Company News

The Anchor Chemical Co., Ltd., announce an interim dividend of 10 per cent. (same).

W. J. Bush and Co., Ltd., announce a net profit for 1941 of £163,278 (£153,013), and have declared a final dividend of 6 per cent., making 10 per cent. for the year (same).

Net profits for the constituent companies of the **Amalgamated Metal Corporation, Ltd.,** for the year ended March 31 last, amount to £264,364 (£400,471).

W. H. Feltham & Son, cotton bag manufacturers, London and Manchester, announce that the future title of the company will be Walter H. Feltham & Son, Ltd.

The Yorkshire Copper Works, Ltd., report a net profit after taxation, of £59,641 (£90,593) and have declared a dividend of 10 per cent. (same).

Sangers, Ltd., report a net trading profit for year ended April 30, of £237,815 (£209,755 for 13 months), and have declared a final ordinary dividend of 15 per cent., making 20 per cent. for the year (22½ per cent.).

New Companies Registered

Arthur Rich & Partners, Ltd. (375,331).—Private company. Capital: £500 in 500 shares of £1 each. Manufacturers of and dealers in chemicals, dyestuffs, paints, varnishes, fertilisers, etc. Subscribers: T. M. Shefford; Irene C. Maher. Solicitors: Albert M. Oppenheimer, 23 Bury Walk, S.W.3.

U.D.A. (Plastics), Ltd. (375,361).—Private company. Capital: £1 in 4 shares of 5s. each. Manufacturers of and dealers in plastic products, plastic powders, glass, refractory materials, chemicals, rubber synthetic materials and products, etc. Subscribers: C. D. Warr; W. E. C. Davies. Registered office: Imperial House, Harley Place, Bristol, 8.

Chemical and Allied Stocks and Shares

ALTHOUGH again inactive in most sections, the undertone of Stock Exchange markets has remained satisfactory, sentiment having been aided by the continued absence of any heavy selling. In most cases, movements were very moderate, and in some directions gains were recorded on balance, prices tending to respond to small improvements in demand, there being shortage of stock in the market owing to the firmness with which securities of all classes have continued to be held.

At 32s. 10½d. Imperial Chemical were within 4½d. of the price ruling a week ago; the 7 per cent. preference units, however,

moved back 10½d. to 32s. 9d. Lever & Unilever were 6d. lower on balance at 28s. 6d., and the 8 per cent. preference eased slightly to 29s. On the other hand, B. Laporte remained firmly held and were again 66s. 3d. W. J. Bush shares remained around 43s. 9d. on the financial results which created an excellent impression; the 10 per cent. dividend is again conservative, and permits substantial additions to be made to the reserve and to the balance carried forward. Following an earlier decline, Dunlop Rubber showed a partial recovery to 27s. 9d., but elsewhere there has been a decline from 11s. 9d. to 11s. in Imperial Smelting. At 11s. 7½d., however, General Refractories were 7½d. above the quotation ruling a week ago. Barry & Staines rallied 1s. 3d. to 32s. 9d., and Nairn & Greenwich were again 51s. 3d., while Wall Paper Manufacturers deferred units were 3d. better at 28s.

Shares of companies with interests in plastics again attracted attention, and Erinoid 5s. ordinary further improved, business having been recorded up to 10s. 6d. Lacrinoid Products 2s. shares were around 4s. 4½d., and British Industrial Plastics 2s. ordinary were 4s. 6d., while Crystalate shares transferred around their par value of 1s. Thomas De La Rue changed hands around 56s. at one time. Elsewhere, British Glues & Chemicals 4s. shares were dealt in at 5s. 9d., and Lawes Chemical at 8s. 9d., while business at 5s. was recorded in Greeff-Chemicals Holdings. Activity continued to be shown in British Plaster Board 5s. ordinary, which were 26s. as compared with 25s. 6d. a week ago. At 66s. British Oxygen were slightly higher, and British Aluminium were firm at 43s. 6d., as were Borax Consolidated at 32s. 9d. British Drug Houses changed hands at 18s. 6d.

Sangers were higher, these 5s. shares being quoted at 17s. following publication of the results. Timothy Whites were 22s. 9d., and Boots Drug 36s. 3d. Triplex Glass at 32s. 4½d. were slightly lower, the disposition being to await the dividend announcement. Tube Investments changed hands more actively, and were around 85s., while Stewarts & Lloyds were 46s., but Staveley shares eased slightly to 42s. 3d. On the other hand, Guest Keen at 24s. 9d. were better on balance, as were Dorman Long at 20s. 3d. Allied Ironfounders further improved to 34s. 6d. Turner & Newall moved back to 67s. 6d., and Murex to 96s. 3d., while the units of the Distillers Co. were 77s. 3d., slightly lower prices having ruled for many of the widely-held securities which invariably tend to move with prevailing conditions on the Stock Exchange. United Molasses at 28s. were 6d. down on balance, but elsewhere there was further improvement in the price of International Paint. Goodlass Wall 10s. ordinary shares were more active, and transferred up to the higher level of 11s. 7½d.

Movements in textile shares were small; Courtaulds and British Celanese eased, but Bradford Dyers and a number of securities of cotton textile companies were inclined to improve. As usual, British Match shares remained firmly held, and at 34s. 6d. were unchanged on balance, while Borax Consolidated were firm at 32s. 9d. Business around 55s. was recorded in United Glass Bottle shares. Anglo-Iranian and other leading oil shares made lower prices.

British Chemical Prices

Market Reports

QUIET conditions are in evidence in most sections of the general chemicals market, mainly on account of seasonal conditions, and there is little of importance to report. There has been no change in the supply position, but deliveries against contracts are reported to be satisfactory. In the soda products section caustic soda, chlorate of soda, and nitrate of soda are in good demand and an active inquiry is reported for soda ash, glauber salt and hyposulphite of soda. The position of the potash products is much the same as reported last week. Elsewhere, white arsenic is a good market, while the demand for acetone and formaldehyde continues to be satisfactory. The oxides are in brisk demand with values firm. Moderate activity is reported in the coal-tar products market this week, but there has been little of fresh interest to record.

MANCHESTER.—Although holiday influences are still in evidence on the Manchester chemical market the position in this respect during the past week has been a little better and a bigger volume of fresh inquiry has been on the market, while delivery specifications against existing contracts are circulating reasonably well. Textile bleaching, dyeing and finishing chemicals are being taken up in fair quantities, and the leading soda, ammonia and magnesia compounds, as well as the acid products, are meeting with a steady demand from most other industrial users. Prices generally fully retain their firmness, with actual changes on balance few and of little consequence. The by-products, with an odd exception, are in brisk demand.

GLASGOW.—Business in the Scottish heavy chemical trade has been rather quieter during the past week both for home trade and export. Prices continue very firm, and where altered, are dearer.

Inventions in the Chemical Industry

The following information is prepared from the Official Patents Journal. Printed copies of Specifications accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.

Applications for Patents

Joining, coating, etc., of metals.—H. Klopstock and A. R. Neelands. 13396.

Manufacture of matches.—K. Lukacs and P. H. Heymann. 13311.

Manufacture of sodium bicarbonate.—W. McGeorge and F. H. Milner. 13605.

Panels, etc., of reinforced plastic material.—A. C. Merron. 13341.

Aluminium alloys.—W. Mills, Ltd., and J. F. Paige. 13401.

Manufacture of 2-amino-thiazole compounds.—Monsanto Chemical Co. (United States, Oct. 29, '40.) 13380.

Process for obtaining clear extracts from semi-liquid mixtures.—M. R. Morgenthaler and Inredeco, Inc. 13518.

Valves for liquids under gas pressure.—E. Rotheim and H. Rotheim. 13405.

Heat control for oil burners.—C. Scott-Snell. 13449.

Viscous solutions of vegetable globulins.—R. H. K. Thomson and Imperial Chemical Industries, Ltd. 13560.

Washing of granular materials.—F. Trostler, W. R. Skelton, L. O. Hanschel and Huntington, Heberlein and Co., Ltd. 13515.

Production of oxide cathodes.—Tungsrám Elektrizitäts A.-G. (Hungary, Oct. 22, '40.) 13516.

Complete Specifications Open to Public Inspection

Autoclaves.—Sulzer Frères S. A. April 19, 1940. 4988/41.

Process for the manufacture of pantothenic acid.—F. Hoffmann-La Roche and Co. A.-G. April 19, 1940. 5745/41.

Process for the preparation of heterocyclic compounds of the thiodiazole series.—Soc. des Usines Chimiques Rhône-Poulenc. April 17, 1940. 7336/41.

Complete Specifications Accepted

Manufacture of meta-oxy-phenylethanolamine.—Soc. of Chemical Industry in Basle. Sept. 14, 1938. (Cognate application, 25738/39.) 540,441.

Synthetic resin adhesives or cements.—N. A. de Bruyne, C. A. A. Rayner, Aero Research, Ltd., and De Havilland Aircraft Co., Ltd. Oct. 13, 1939. 540,442.

Chromium recovery.—M. J. Udy. Jan. 25, 1939. 540,364.

Refractory blocks and method of producing the same.—R. Haddan (Corning Glass Works). Dec. 13, 1939. 540,484.

Compositions for the treatment of plants.—American Chemical Paint Co. Dec. 23, 1938. 540,485.

Catalytic cracking of hydrocarbon oil.—Standard Oil Development Co. March 11, 1939. 540,408.

Extraction of gelatine from ossein.—A/S. Dansk Gerings-Industri. Feb. 11, 1939. 540,369.

Process for carrying out oxidation reactions.—J. G. Fife (N. V. de Bataafsche Petroleum Mij.). Feb. 9, 1940. 540,370.

Apparatus adapted for use in the extraction of fats.—V. Silberstein. Feb. 16, 1940. 540,486.

Production of saturated hydrocarbons.—Anglo-Iranian Oil Co., Ltd., and S. W. Adey. March 8, 1940. 540,449.

Calcium sulphate plasters.—V. Lefebure and Imperial Chemical Industries, Ltd. April 8, 1940. 540,415.

Method of manufacturing composite lead powder for the electrodes of storage batteries.—S. Isaki. April 9, 1940. 540,330.

Monoalkylol cyanamide condensation products.—American Cyanamide Co. June 10, 1939. 540,376.

Magnesium-base alloys containing metals of the cerium group of rare earths substantially free from cerium.—Magnesium Production Co., Ltd. April 21, 1939. 540,333.

Moulding compositions.—Bakelite, Ltd. Aug. 8, 1939. 540,383.

Production of glyceric aldehyde α-methyl ether.—E. I. du Pont de Nemours and Co. April 13, 1939. 540,418.

Iodine-containing dyestuffs.—Ward, Blenkinsop and Co., Ltd., A. A. Goldberg, and B. P. H. Wiesner. April 16, 1940. 540,455.

Alkylation of hydrocarbons and the production of high anti-knock hydrocarbons.—Texaco Development Corporation. May 4, 1939. 540,459.

Liquid-spraying devices.—J. G. A. Bickford and M. M. Clark. May 1, 1940. 540,339.

Means for controlling automatically the temperature of coke ovens.—G. Cellan-Jones and Gibbons Bros., Ltd. May 8, 1940. 540,461.

Mill for mixing plastic material.—Firestone Tyre and Rubber Co., Ltd. Sept. 29, 1939. 540,341.

Materials and articles made from bonded inorganic fibres.—Glass Fibres, Ltd., and A. M. Hallawell. May 31, 1940. 540,342.

Process for the purification of water.—Celec Corporation, Ltd., and A. Baker. June 10, 1940. 540,504.

Electrical precipitation of suspended particles from a stream of gas.—Lodge-Cottrell, Ltd. (International Precipitation Co., Inc.). July 8, 1940. 540,508.

Process and apparatus for removing adherent coatings from rigid surfaces.—Dunlop Rubber Co., Ltd., D. F. Twiss and F. A. Jones. July 18, 1940. 540,510.

Scrapers for sedimentation tanks.—C. J. Hartley. Aug. 21, 1940. 540,432.

Composition for producing gas-tight seals between metallic moving parts.—C. W. Renn. Sept. 19, 1940. 540,352.

Nickel-iron alloys.—Mond Nickel Co., Ltd. Oct. 27, 1939. 540,357.

Metal compositions.—Mallory Metallurgical Products, Ltd. June 22, 1940. 540,360.

Treatment of light-metal cartridge cases.—Aluminium Industri A.-G. Nov. 28, 1939. (Addition to 528,114.) 540,522.

Electrodeposition of metals.—Mallory Metallurgical Products, Ltd. Dec. 19, 1939. 540,437.

Methods of effecting the removal of scale deposits from moulds employed in glass manufacture.—United Glass Bottle Manufacturers, Ltd., and T. C. Moorshead, jun. Feb. 24, 1941. 540,481.

Processes and mash for the production of riboflavine by butyl-alcohol-producing bacteria, and the products resulting therefrom.—Commercial Solvents Corporation. Oct. 24, 1940. 16445/7.

Manufacture of methylol amides.—E. I. de Pont de Nemours and Co. Oct. 25, 1940. 11892.

Coated products and coating processes.—E. I. du Pont de Nemours and Co. Oct. 21, 1940. 12109.

Condensation products.—British Thomson-Houston Co., Ltd. Oct. 26, 1940. 13621.

Cellulose ether derivatives and process for producing the same.—Carbide and Carbon Chemicals Corporation. Oct. 19, 1940. (Cognate application, 14241/41.) 14240.

Process for improving the agglomerating or drying of pulverulent materials by vibration.—Compagnie Nationale de Matières Colorantes et Manufactures de Produits Chimiques du Nord Réunies, Etablissements Kuhlmann, and Passelecq, G. Oct. 21, 1940. 4023.

Production of colour resists under aniline-black.—Durand and Huguenin A.-G. (Aug. 11, 1938.)* 23089.

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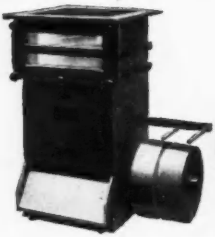

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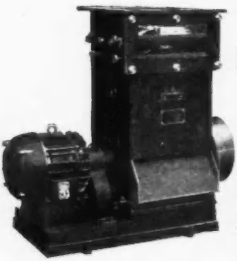

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